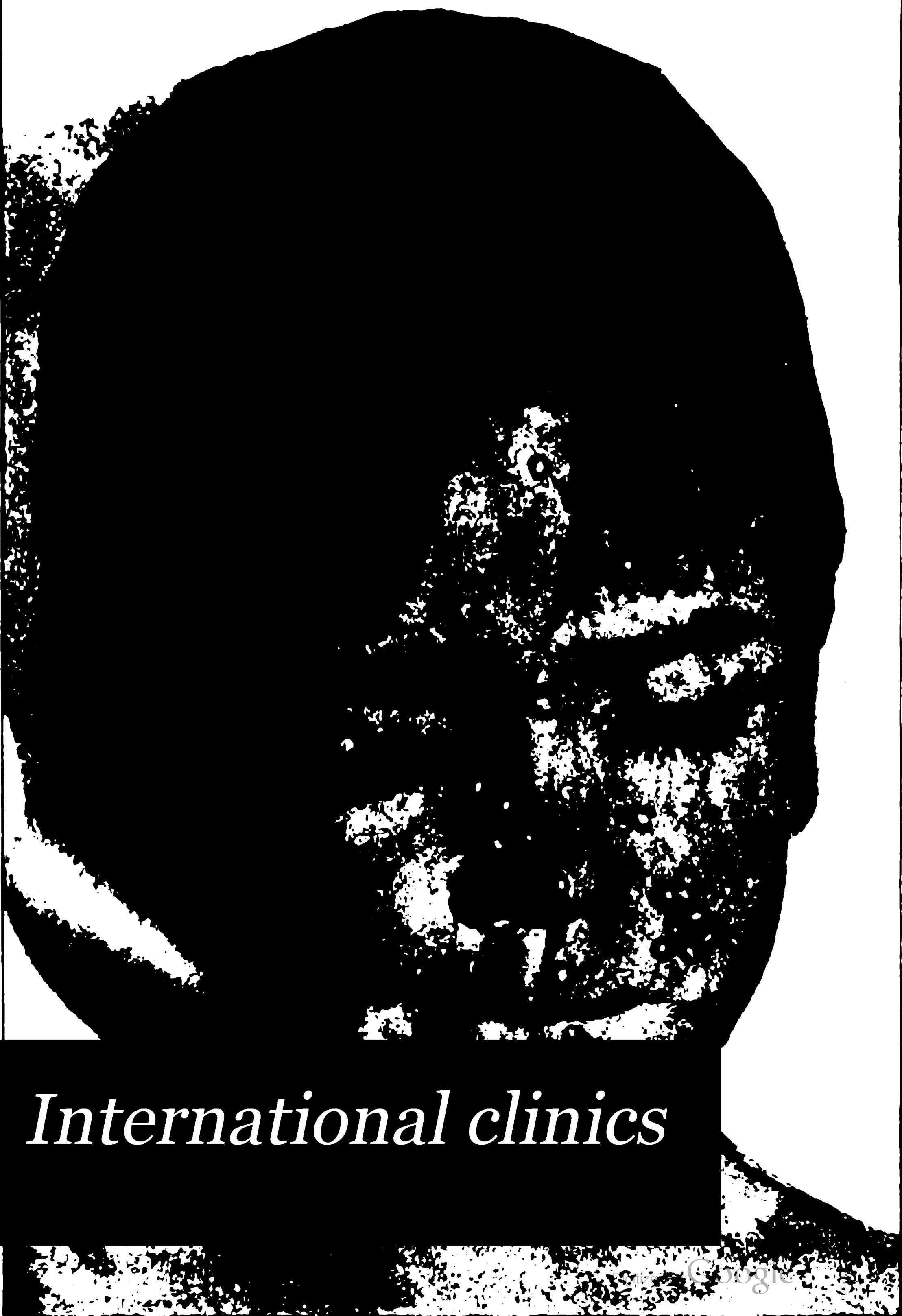


International clinics

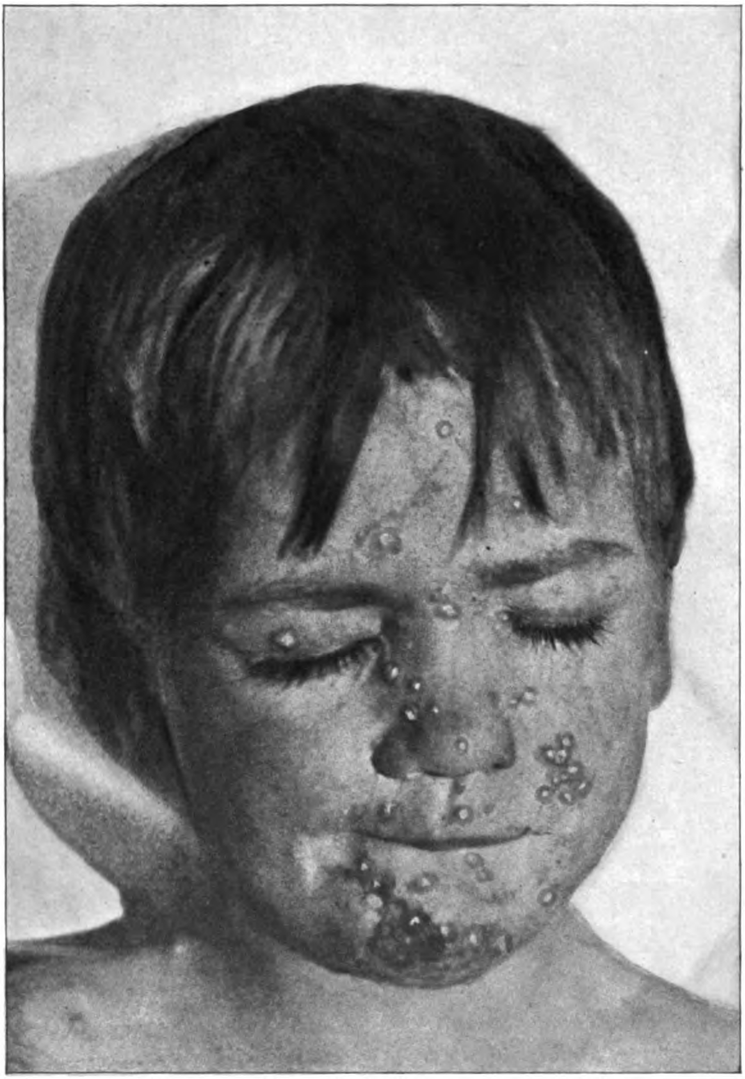


FIG. 1.—Extremely mild variola, with a typical grouping resembling febrile herpes. Upon the chin there had been a patch of eczema. (See page 79.)

INTERNATIONAL CLINICS

A QUARTERLY

OF

CLINICAL LECTURES AND ESPECIALLY PREPARED ARTICLES

ON

MEDICINE, NEUROLOGY, SURGERY, THERAPEUTICS, OBSTETRICS, PÆDIATRICS, PATHOLOGY, DERMATOLOGY, DISEASES OF THE EYE, EAR, NOSE, AND THROAT, AND OTHER TOPICS OF INTEREST TO STUDENTS AND PRACTITIONERS

BY LEADING MEMBERS OF THE MEDICAL PROFESSION THROUGHOUT THE WORLD

EDITED BY

HENRY W. CATTELL, A.M., M.D., PHILADELPHIA, U. S. A.

WITH THE COLLABORATION OF

JOHN B. MURPHY, M.D., OF CHICAGO; ALEXANDER D. BLACKADER, M.D., OF MONTREAL

H. C. WOOD, M.D., OF PHILADELPHIA; T. M. ROTCH, M.D., OF BOSTON; E. LANDOLT, M.D., OF PARIS

THOMAS G. MORTON, M.D., CHARLES H. REED, M.D., OF PHILADELPHIA

J. W. BALLANTYNE, M.D., OF EDINBURGH, AND JOHN HAROLD, M.D., OF LONDON

WITH REGULAR CORRESPONDENTS IN MONTREAL, LONDON, PARIS, LEIPSIC, AND VIENNA

VOLUME II. ELEVENTH SERIES, 1901

PHILADELPHIA

J. B. LIPPINCOTT COMPANY

1901

PRINTED BY J. B. LIPPINCOTT COMPANY, PHILADELPHIA, U.S.A.

CONTRIBUTORS TO VOLUME II.

(ELEVENTH SERIES.)

Ballantyne, J. W., M.D., F.R.C.P.E., F.R.S. (Edin.), Lecturer on Midwifery and Gynæcology, Medical College for Women, Edinburgh; Lecturer on Antenatal Pathology and Teratology in the University of Edinburgh (1900).

Blackader, A. D., M.D., Professor of Pharmacology and Therapeutics and Lecturer on Diseases of Children, McGill University; Physician to the Montreal General Hospital, etc.

Bolton, B. Meade, M.D., Formerly Professor of Pathology and Bacteriology, University of the State of Missouri.

Broca, A., M.D., Surgeon to the Paris Hospitals.

Buist, R. C., M.A., M.D., Gynæcologist to the Dundee Royal Infirmary.

Cajal, Santiago Ramon y, Professor of Anatomy and Histology at the Royal University of Madrid, Spain.

Casselberry, W. E., M.D., Professor of Laryngology and Rhinology, Northwestern University Medical School, Chicago.

Chauffard, A., M.D., Physician to the Paris Hospitals.

Deaver, John B., M.D., Surgeon-in-Chief to the German Hospital, Philadelphia.

Dolèris, A., M.D., Accoucheur to the Paris Hospitals.

Dorland, W. A. Newman, M.D., Associate in Gynæcology, Philadelphia Polyclinic; Author of the American Illustrated Medical Dictionary, etc.

Douglas, Carstairs, M.D., B.Sc., F.R.S. (Edin.), F.F.P. & S. (Glasgow), Professor of Medical Jurisprudence, Anderson's College Medical School, and Director of the West of Scotland Clinical Research Laboratory, Glasgow.

Fournier, Alfred, M.D., Professor of Venereology at the Paris Faculty of Medicine.

Fowler, J. S., M.D., F.R.C.P. (Edin.), Extra Physician, Royal Hospital for Sick Children, Edinburgh.

Frenkel, H. S., M.D., Inventor of the Systematic Movements for the Cure of Incoördination and Director of the Freihof Sanitarium in Heiden, Switzerland.

Griffith, John, F.R.C.S. (Eng.), Surgeon to the Royal Westminster Ophthalmic Hospital, London.

Hektoen, Ludvig, M.D., Professor of Pathology in the Rush Medical College, of Chicago.

JARDINE, ROBERT, M.D., (Edin.), M.R.C.S. (Eng.), F.F.P. and S. (Glasgow), Physician to the Glasgow Maternity Hospital; Examiner in Midwifery to the University of Glasgow; President of the Glasgow Obstetrical and Gynæcological Society.

SCHAMBERG, JAY F., M.D., Professor of Diseases of the Skin at the Philadelphia Polyclinic and College for Graduates in Medicine.

SCHLICHTING, EMIL, Assistant Chemist to the Dairy and Food Commission, Department of Agriculture, Pennsylvania.

SEWALL, HENRY, Ph.D., M.D., Denver Colorado.

SHOEMAKER, WILLIAM T., M.D., Assistant Ophthalmologist and a Chief of the Eye Clinic to the German Hospital; Dispensary Ophthalmic Surgeon to the Presbyterian Hospital, Philadelphia.

STARR, M. ALLEN, M.D., LL.D., Professor of Diseases of the Mind and Nervous System, College of Physicians and Surgeons, Medical Department of Columbia University, in the City of New York.

TUFFIER, T. H., Assistant Professor at the Faculty of Medicine of Paris.

TURCK, FENTON B., M.D., Professor in the Post-Graduate Medical School of Chicago.

TYSON, JAMES, M.D., Professor of Medicine in the University of Pennsylvania.

WATHEN, JOHN R., A.B., M.D., Professor of Pathology and Clinical Professor of Gynæcology in the Kentucky School of Medicine.

WLAEFF, DR., Privat-docent of the Academy of Medicine of St. Petersburg.

CONTENTS OF VOLUME II.

(ELEVENTH SERIES.)

THERAPEUTICS.

MEDICINE.

NEUROLOGY.

SURGERY.

OBSTETRICS AND GYNÆCOLOGY.

PÆDIATRICS.

PATHOLOGY.

DISEASES OF THE EYE.

LARYNGOLOGY.

MISCELLANEOUS.

LIST OF ILLUSTRATIONS TO VOLUME II.

(ELEVENTH SERIES.)

PLATES.

FIGURES.

Therapeutics

TREATMENT OF ATONY OF THE STOMACH AND COLON.

BY FENTON B. TURCK, M.D.,
Professor in the Post-Graduate Medical School of Chicago.

The term "atony" designates a weakness of the muscular walls of the stomach and intestines, a lack of tone, a loss of power to propel the contents of the digestive tract. A gradually increasing obstruction does not cause atony until the obstruction is practically complete; in partial stenosis hypertrophy is the rule. All cases of stenosis due to malignant or benign growths are surgical cases. Dilatation frequently occurs as the result of atony, even in the absence of obstruction. The following interesting case, reported in 1899,[1] will serve as an illustration.

Mrs. F. C., aged thirty-three, September 17, 1895. Patient had received hospital treatment, consisting in lavage, diet, and general medication, for three months, without benefit. When referred to me, she complained of great distress in the epigastrium, severe attacks of gastralgia, headache, insomnia, marked general weakness, constipation alternating with diarrhœa, and frequent vomiting, occurring especially from six to eight hours after meals. She had during the two preceding years lost sixteen kilograms in weight. Patient had suffered from gastric derangement for eight years. Examination next day showed the thoracic organs to be practically normal. On passing the long flexible gyromele (revolving sound) into the stomach, the greater curvature was found six centimetres above the symphysis pubis, the lesser curvature at about the lower epigastric border. The area of the stomach extended laterally to

[1] Turck, Motor Insufficiency of the Stomach, North American Practitioner, February, 1899, vol. xi. No. 2, p. 65.

the right mammary line. A sponge attached to the end of the cable passed through the pylorus and became saturated with bile; on aspiration no bile was found in the stomach. The latter contained remnants of food and 0.28 per cent. of free hydrochloric acid. A test meal of meat and rice had not passed out of the stomach ten hours after ingestion. Diagnosis: dilatation of the stomach, gastric myasthenia, motor insufficiency, and hyperchlorhydria. The treatment, consisting of pneumatic gymnastics of the stomach and the use of the gyromele, liberal diet, restricted to two meals a day, and a cupful of bran and hot water three times a week, was followed by complete disappearance of all subjective symptoms, with a marked improvement of the anatomical changes,—*i.e.,* dilatation and prolapsus. The case has been under observation from 1895 to the present time. Reports showing the permanency of the results are found in the article referred to above.

Atony of the stomach is observed as a concomitant of prolapse. The stomach is not only easily distended, but, especially the pyloric part, drops down, pushing with it the transverse colon. These conditions are very often found associated with marked constipation, but the relation between cause and effect is difficult to determine. As Ewald has remarked, it is frequently necessary to treat the effect in order to have the causes disappear.

An elaborate study of the etiology of atony is of minor importance to the general practitioner, but the essential points to be determined are (1) the presence of atony, (2) its degree, and (3) the methods of treatment.

The importance of recognizing and correcting atony of the stomach, disregarding even grave pathologic conditions such as *atrophy,* is demonstrated by the following cases.

Dr. C. V. W., aged forty-eight, enjoyed fairly good health up to one year before he was referred to me for treatment. Patient first noticed loss in weight, distress in the epigastric region three or four hours after meals, and constipation. He was examined by a number of physicians, who found absence of hydrochloric acid and the ferments, with presence of lactic acid, rapid emaciation, general appearance approaching that of cachexia, and consequently cancer of the stomach was diagnosed. During lavage of the stomach, I found a piece of loosened membrane in the wash-water, the microscopic examination of which revealed atrophy of the gland tubules.

Remnants of food were found upon the walls of the stomach twenty-four hours after a meal; food remaining in the lumen of the organ twelve hours after eating, no marked enlargement of the gastric area, but retention was evident. No palpable tumor. The pylorus was patulous. Diagnosis: gastritis atrophica, with motor insufficiency and retention. Treatment for six weeks by methods described in this paper resulted in a complete disappearance of the symptoms complained of and an increase in weight. The patient was examined two years later, showing no return, however, of hydrochloric acid or the enzymes, but enjoying good health and freedom from all symptoms of carcinoma.

It is evident that the most important symptom in this case was atony of the stomach and intestines, and that when this condition was corrected there was disappearance of all the subjective and many of the objective symptoms, so that the patient now enjoys life, notwithstanding the absence of *glandular* activity of the stomach. It must be remembered, of course, that patients with glandular atrophy of the stomach must exercise more caution in their diet and habits of living than an individual blessed with a normal stomach. The rapidity with which the condition of atony of the stomach and intestines has been corrected in cases where it had existed for quite a number of years is indeed remarkable.

Mr. S. F. L., aged forty (presented before the Chicago Medical Society in 1899), suffered from atony of the stomach and intestines in consequence of malaria. Stomach symptoms had existed for seventeen years, and had been treated according to various recognized methods, with negative results. After a treatment of two months the atony, which was found to be the cause of his trouble, entirely disappeared, with a gain in weight of ten kilograms. Patient has since remained in vigorous health, with the motor power of the stomach and intestines normal.

Methods and Technique of Treatment (*Indications and Contra-indications for Lavage*).—According to Ewald, lavage of the stomach is the sovereign remedy in these gastric disturbances, but, states this eminent clinician before the British Medical Society, 1898, if it does not give immediate relief, its use must be discontinued at once, and in any event it is to be used for only a short time. The reason for this is very evident when we remember that, each time the dilated and weakened stomach is washed, the secretions, hydro-

chloric acid and pepsin, necessary for digestion, and the partly digested food are removed, and that thus the patient is deprived of the very nutrition that he is in need of. I have had frequent occasions to confirm the truth of Ewald's conclusions. Most of the patients referred to me had had their stomachs washed not only without benefit, but with actual injury.

The benefits of lavage are due to its mechanical effect. Its physiologic action is the stimulation of the circulation in the walls of the stomach, of the muscular tone, and of the peristaltic activity. The old method of lavage consists in the introduction of water into the stomach through a soft tube and the withdrawal of the water through the same tube used as a siphon. In order to obtain greater stimulative effects and remove adhering mucus from the gastric mucosa, I have devised a "needle douche." This is a double tube consisting of an afferent shorter tube, terminating, when introduced, at the cardiac end, and a longer efferent tube, which reaches the greater curvature. The blind end of the afferent tube is provided with a number of perforations, which, when water is introduced under pressure, vigorously project a corresponding number of fine needle-like jets of water against the walls of the stomach, the action being similar to that of a shower-bath on the skin. There is no great accumulation of water in the stomach, since the water passes out of the efferent canal of the double tube, the open end of which lies, as has been said, at the deepest point of the stomach,—viz., the greater curvature. It is readily seen that the walls of the stomach are more thoroughly cleansed by this method than by ordinary lavage. It must also be remembered that the benefits of lavage depend upon the gymnastic effects of the same, as first suggested by Ewald, who, quoting from Oser, states that lavage "causes a healthy reaction." More recently Fleiner observed that the chief benefits of lavage are due to distention of the stomach with water, stretching its muscular walls, and withdrawal of same, followed by contraction, the whole procedure acting as gymnastics of the stomach. Von Ziemssen has called attention to this gymnastic effect of lavage, and has further shown that the peristalsis is increased not only in the stomach, but also in the entire intestinal tract, and he has therefore advocated the use of gastric lavage as a remedy for constipation. Ewald, however, had long before demonstrated clinically the benefits of lavage for constipation, but, as mentioned above, this author also shows that

lavage can be used only for a very short period, and that unless *immediate* results follow its use will not be beneficial.

Treatment by means of lavage should not be prolonged, for the following reasons: 1. In obtaining the gymnastic effect of lavage the secretions of the mucosa are washed away. 2. Remnants of food, albumoses, peptones, and other nutritive material, usually found in the atonic stomach, are washed out, and this loss of nutrition results in emaciation of the patient. 3. Water in direct contact with the mucosa seems to act as an irritant, especially when continually used, thus aggravating the glandular disturbance often associated with atony of the stomach.

In order to avoid these disadvantages of lavage, the author has introduced into the stomach a rubber bag attached to the end of a double tube, and filled it with water, which is allowed to escape in the usual manner, instead of bringing the water in contact with the mucous membrane. In many cases of atony I have found this procedure of great value in stimulating the muscularis of the stomach, and thus increasing peristalsis, without removing the secretions of the stomach or remaining food.

Gymnastics of the stomach produced by the use of lavage depend upon the weight and bulk of the water distending the organ, and it is therefore clearly seen that only the lower portion,—viz., the greater curvature—is thereby "exercised." Moreover, in cases of prolapsus a weight of one or two pounds of water will only increase the trouble, since the weight of the water, which is also non-compressible, causes chiefly a downward pressure. It has, therefore, been found preferable to use air instead of water. Air introduced into the stomach will distend the organ uniformly in all directions. Air is compressible, and while it stretches the stomach walls it permits the stomach muscles to contract, causing isometric contractions. Through the contraction of the stomach after inflation, together with the contraction of the abdominal wall and intra-abdominal pressure, the air is forced out again. This method has been seen to increase peristalsis without causing fatigue. The air can be heated before introduction by passing it through water of a temperature of 55° C. (131° F.). The moist hot air passes through the afferent canal of the double tube, distends the entire stomach, its heat stimulating the circulation of the gastric walls, and again passes out through the efferent canal of the double tube.

Where desirable, volatile oils, such as oil of cloves or of cinnamon or menthol, may be added to the hot water. The watery vapors are thus impregnated with the volatile substances and come in contact with the mucosa of the stomach. Some cases require dry air for treatment. Here the air is heated by being conducted through heat coils and hot chamber especially devised for this purpose. Cold air is also of value, especially after the use of the hot moist air. The effect of gymnastics of the stomach produced by these methods is prompt and permanent. I have found that within one month of treatment, using the method once daily for the first week and subsequently every other day, the dilated stomach would retract and peristalsis would increase so that the organ would empty itself within the normal limit of time. In cases of marked gastric myasthenia it may be found necessary to give two treatments daily, one before breakfast and one before dinner. The peristalsis thus started by the pneumatic gymnastics will often continue until the contents are expelled, overcoming the stagnation and relieving the distress.

In many cases of atony the chief fault lies in the antrum pylori, which may be markedly dilated, the pouch of dilatation affording a favorable place for accumulation of food. It is then desirable to exercise this portion separately. For this purpose, the intragastric bag above described is introduced into this region, which can be easily determined by inflating the introduced bag and percussing the abdominal wall over this area, or it can be located by palpation, using the gyromele introduced into the bag.

Another advantage of the bag is due to its greater elasticity, which expels the introduced air much more rapidly than the contraction of the stomach; hence a higher degree of gymnastic exercise is obtained. This has been demonstrated experimentally in the dog's stomach.[1] There is, furthermore, no escape of air from the bag through the pylorus into the intestine or along the tube through the cardia. For ordinary purposes, however, the method of introducing air directly into the stomach is quite sufficient.

Technique of Pneumatic Gymnastics of Stomach and Colon.—The double-current tube is introduced into the stomach in the usual manner. The narrower entrance or afferent tube is connected with

---

[1] Turck, British Medical Journal, October 29, 1898, p. 1828.

a tank containing compressed air or with an ordinary rubber bulb. (The use of compressed air has many advantages over the compressible rubber bulb.) The air, having distended the organ, escapes through the wider outlet or efferent tube. If the air is to be heated, it is passed through water of a temperature of 55° C. (131° F.), contained in a gallon bottle one-half filled. The bottle is closed with a rubber stopper, through which pass two glass tubes. The longer tube reaches almost to the bottom of the bottle, thus being immersed in the water, and is connected with the bulb or air-tank. The shorter tube, reaching about one and a half or two inches into the bottle, serves as an exit for the air which has passed through the first tube and the hot water. To the shorter or exit tube is attached the stomach-tube, after having been introduced. The air, therefore, passes first through the hot water, then into the stomach, which it distends, and finally escapes through the wider outlet or efferent canal of the double tube. By compressing the outlet tube, the stomach may be inflated to any desired degree; on releasing the confined air, the viscus will relax again. Repeating this process results in alternating distention and relaxation of the stomach, a stimulative process which is immediately followed by spontaneous vigorous contraction of the organ. The colon is treated in a similar manner, but here the distention must be slower than in the stomach and care be taken not to cause a feeling of distress. The duration of the treatment is from five to fifteen minutes.

Combined Massage with Pneumatic Gymnastics.—The patient is placed upon a couch or table, the tube is introduced as above described, and the stomach is inflated with air. Massage is now applied to the distended organ, and thus the air is forced out again. Massage of the stomach by this method is more direct than without inflation, and a larger gastric area is reached; thus the value of the gymnastic effect of gastric massage is greatly enhanced. When the colon is inflated with air and the tube is left *in situ,* the outlines of the distended large intestine can be readily seen. Massage is now begun at the cæcum and continued over the ascending, transverse, and descending colon, thus forcing all the air out through the tube. The stimulating effect of this repeated process upon the colon results in peristaltic reaction, overcoming the atony, thus affording a most useful method of treatment for chronic constipation.

It is frequently of advantage to massage the inner wall of the

stomach or colon by the use of the gyromele, which is introduced into the organ in the usual manner. By means of the rotating apparatus (drill), revolutions of the sound are produced which can be palpated upon the abdominal wall. The value of this treatment depends upon the vibratory effect of the revolutions and the contact effect produced thereby, thus acting as a local massage, and also upon the slight stretching and relaxing of the organ upon introduction and withdrawal of the revolving sound. The use of the gyromele is very beneficial in connection with faradization and galvanization; by using the cable No. 3 (very flexible) electricity can be applied to the entire inner wall, or to any selected area of the organ. Its use in the colon has been warmly recommended by Herschell,[1] who finds it a practical method of colonic electrization.

Dietetics.—The aim of dietetic treatment in atony of the stomach and intestines is the variation of the class, preparation, and quantity of food and the intervals between eating according to the condition of the patient. The degree of digestive and peristaltic activity of the stomach and intestine must also be considered. Only after an accurate determination of these conditions can a rational plan of dietetics be instituted. In weakness of the muscle wall of the stomach a diminished load of ingesta at each meal would seem to be indicated, in order to lighten the work of digestion. This would mean, if the amount of food were reduced to one-quarter or one-third of the usual quantity, a considerable deficit of nutrition and a proportionate degree of starvation.

In order to maintain the metabolic equilibrium with reduced amounts of food, the Germans have recommended reduced rations often repeated,—*i.e.,* an increase of the number of meals per day. If, *e.g.,* only fourteen or fifteen hundred calories can be taken (instead of the normally required three thousand), this is divided into seven parts of about two hundred calories each, taken at the following hours: 6.30 A.M., 8 A.M., 10 A.M., 12 M., 3 P.M., 7 P.M., and 10 P.M. (Wegele, Leube, Penzoldt). This method of frequent feeding has been copied extensively by American practitioners. Theoretically the system seems to meet the indications, and the author has in the beginning of the treatment seen amelioration of the subjective symptoms of distress after eating. This seeming

[1] On Constipation, London, 1899.

improvement is easily explained. The stomach, accustomed to a large supply of food, will certainly not suffer from the introduction of one-third of the usual amount. Later, however, the distress after eating is aggravated as food residue begins to accumulate, the stomach not having had time to empty itself of the first meal when the second one is introduced. Hence no improvement of muscle tone can be expected from this treatment; in fact, the constant work demanded by it from the stomach tends to exhaust an already weakened muscular wall without an adequate rest pause. The difficulty lies not so much in the inability of the stomach to sustain a load as in the fact that the stomach muscle is soon exhausted, so that the gastric contents are not sufficiently churned and are not poured into the intestine within the normal space of time. Thus, I have frequently seen a small Ewald test meal of toast and tea retained in a myasthenic and dilated stomach as long as a larger quantity of food. Another important question involved is that of giving the muscle the physiologically required pause of rest, which must be prolonged in proportion to the greater fatigue of the weakened muscle wall. Thus, we conclude that the frequent-meal plan is a violation of universally recognized laws of physiology, and that its practice is not only without value, but decidedly harmful, the residue of meals giving rise to an undesirable fermentation.

In mild cases of atony almost any change of diet may be useful from its psychical effect. It is not advisable to prescribe a monotonous bill of fare, but our aim should be at a pleasant variation of the menu. Man requires a mixed diet of meat and vegetables, and a better food than that furnished by nature has not yet been discovered. The less artificial interference the higher is, as a rule, the nutritive value and often the digestibility of food. All pharmaceutical preparations, such as "predigested" food and other laboratory products as substitutes for natural food, are to be condemned and disregarded in the treatment of atony. Judicious cooking, however, will not only often improve the digestibility of food, but also afford a pleasant variety to the palate.

Chopped beef may be given prepared in the following different styles. (*a*) Broiled meat cakes: from one hundred to one hundred and twenty-five grammes of lean chopped beef are freed from tendinous material (white connective tissue) and shaped into flattened cakes; these are held close to a fire long enough to coagulate

the peripheral albumen and form a crust; they are then "done," according to taste, by more distant heat on a broiler frequently turned (like a spit), which converts the connective tissue into gelatin. They are then seasoned according to taste and indications. (*b*) About five hundred grammes of finely chopped meat are placed in a Mason jar, covered with two hundred and fifty cubic centimetres of water, and the tightly closed jar is exposed to moderate heat for a few hours; this makes a semi-solid mass, and can be served with fresh butter and, when not contraindicated, salt and pepper. (*c*) Meat and bread crumbs: one hundred grammes of finely chopped beef or mutton are mixed with fifty grammes of fine white bread-crumbs and two hundred grammes of milk, seasoned with a little bay-leaf if desired. The mass, covered with paraffin paper, is placed in an earthen dish and baked. Served hot or cold, it is delicious, easily digested, and nutritious. (*d*) Raw meat sandwiches are relished very much by some patients.

Bread with a liberal amount of butter is the means of supplying the carbohydrates and fats. I have often seen patients with marked atony thrive well on this simple bill of fare, especially when only two meals per day were taken. It rests upon the tact and judgment of the physician to arrive at the minute details of feeding; the above outlines are given merely as a basis to be built upon.

In cases complicated with constipation due to atony of the intestines, coarse food is indicated, which should at the same time be more or less chemically inert. Different kinds of coarse bread, as Graham, pumpernickel (rye-bread), etc., have been recommended. I have found bran very beneficial and have for several years advocated its use. The preparation of the bran is simple and can be varied to suit the case. Coarse bran is procured from the feed-store. To sterilize it and convert the starch granules into dextrin, it is exposed to a dry temperature of 150° C. (302° F.). I have found that "bran gems," prepared in the following manner, are relished by many patients. To the sterile bran are added sufficient Graham flour and water to make adherent masses, also a little salt, and the dough is baked in cast-iron patty-pans, the same as are used in baking Graham gems. Another way to prepare bran is to mix it with flour, preferably gluten flour, and bake it as ordinary bread. A cupful of bran mixed with boiling water, cream, or milk and served like porridge is simple and useful. Quantity and time of

administration must be regulated according to results desired and obtained. I have made extensive experimental studies on the action of bran and reported the same.[1] In the treatment of constipation due to atony these various methods are combined to obtain prompt and lasting effects.

In describing the methods of gastric gymnastics, I have mentioned the introduction of air into the colon of atonic patients and its removal therefrom by massage. I would rather advocate this treatment than that of distending the colon with water, if introduced solely for the purpose of distention and relaxation. I have devised a method, however, for stimulation of the colon and adjacent viscera, and principally the splanchnic circulation, by heat, of which a short description will not be amiss. The patient is placed in the dorsal position, with elevation of the lower extremities, similar to that for gynæcologic examinations. A colon tube is inserted a few inches into the rectum. Water (0.8 per cent. salt solution) at a temperature of from 50° to 55° C. (122° to 131° F.) is now introduced. This temperature is required for stimulation of the nerve endings of the colon, and, since that organ is devoid of sensibility for heat, pain need not be feared. The quantity of hot water thus introduced must not exceed three hundred cubic centimetres. Since distention of the bowel is not the object of this treatment, any distress caused by over-distention is to be avoided. The water is allowed to escape after a few moments, and is replaced by a new supply at 55° C. This is continued until a marked subjective feeling of heat throughout the entire abdominal viscera is obtained, which usually occurs in from twenty to thirty minutes. It may then be followed by a flushing of the colon with ice-water. I have demonstrated the stimulating effect of this treatment on dogs, and have used the procedure with highly gratifying results for a number of years in cases of constipation due to atony. In cases of impaction constant irrigation with water at a temperature of 50° C. (122° F.) is of great value.[2] Herschell and Treeves have also strongly advocated these procedures in various pathologic conditions of the abdominal viscera.

---

[1] New York Medical Journal, March, 1897.

[2] For a more detailed description of these methods and experimental studies the reader is referred to Turck on Treatment of Abdominal Viscera through the Colon, Journal of the American Medical Association, October 7, 1899, and May 5, 1900.

As a supplementary method of exercise to the abdominal viscera, I have found my H exerciser very useful. This simple apparatus consists of two double cords stretched from the top of a door-way to the door-sill beneath, running parallel to each other from two and a half to three feet apart, a horizontal bar being placed at about the height of the extended arms. Hence the name "H exerciser." The double cords are so attached to the bar that this may slide up and down with friction resistance. The extended hands, grasping the horizontal bar, push it forward and withdraw it, in a motion similar to turning a grindstone. The arms and legs should not be flexed, but kept rigid, thus throwing the work upon the body. As the body is bent forward and downward, there is resistance from the cords from above and below, and as the circle is completed in coming backward and upward, there is again resistance, but in the opposite direction. A period of rest occurs when the cycle is complete, giving ample time for equalization of the circulation. In the beginning a pause of about two minutes should follow after five cycles, the number of which are to be increased day after day until twenty-five cycles are made between rest periods. The physician should regulate the amount of exercise according to indications.

In conclusion, let me again call your attention to the treatment of the abdominal viscera by the application of heat. It should be remembered that the benefits of this treatment are due not only to its local action, but also greatly to the effect of heat on the general metabolism. We admit that very little is known about the exact physico-chemism of tissue change; we do know, however, that a rise in the temperature of the system, especially in that of the blood, markedly increases the interchange of matter between the blood and the tissues of the body. This is shown by the ravenous appetite developed after fever, and I have often had opportunity to see a similar improvement of appetite and proportionate increase of weight in patients under this treatment. The heat applied in the colon raises the temperature of the blood, which in turn acts on the tissue-cells, stimulates the nervous mechanism, and thus gives rise to increased cellular activity in tissues and organs throughout the body.

SURGICAL ANALGESIS BY INJECTIONS OF COCAINE INTO THE SPINAL COLUMN.

BY T. H. TUFFIER,

Assistant Professor at the Faculty of Medicine of Paris.

In May of last year I published the technique that I had adopted and the results obtained since November 4, 1899, in surgical analgesis from cocaine injections by the spinal route. This technique has been followed by every one who has confidence in the method. Since the publication of the article just mentioned my personal experience has become greater, and I wish now to report on the two hundred and fifty-two operations that I have performed,—not so much in order to make known the process as to put on their guard those who have followed my line of action, and to advise them to be very cautious if they wish to avoid trouble and failure. In the remarks that I am about to make I shall try to keep apart as well from all systematic and theoretic opposition to the method as from any attempt blindly to recommend it for all cases.

I have now used the method for more than a year and have seen many of my patients a long time after the operation, and the facts that I think can be regarded as established are as follows: The injection of cocaine into the spinal column, which should be made aseptically and according to the rules of my technique, causes entire analgesis of the portion of the body below the diaphragm for a length of time sufficient to enable me to perform all my operations. It causes no risk, either immediate or remote, to the nervous system. I have never noticed any local, operative complication that could be ascribed to it, and have always been able to operate in the lateral position or Trendelenburg's position as easily as with ordinary anæsthetics. I was at first doubtful as to the moral effect on the patient; but found, particularly with men and in private practice, the most complete indifference to the operation, so that I have now practically abandoned all subterfuge on that score. Only one of my patients succumbed; he was afflicted with eventration, and died the day after the operation. Post-mortem showed old and serious car-

diac lesions, with pulmonary congestion and œdema, which showed that the fatal result was inevitable. None of my other operations were in any way influenced by the method. After having experimented with various narcotics, such as trinitrine, morphine, atropine and eucaine alpha and beta, I gave them up. Many operators who have used my technique make injections of caffeine or ether, to counteract the effect of the cocaine during the operation; but my experiments have led me to consider these injections inefficacious and useless in the great majority of cases. Patients operated by this method show no signs of shock; their return to a physiological condition is much quicker than after general anæsthesia.

These facts being definitely established, all discussion must bear on other points, which will now be considered. Are the immediate and consecutive phenomena due to the method of such a nature as to render it inadvisable; in other words, are the disturbances caused by it serious or sufficiently disagreeable to warrant us in always preferring the use of such a general anæsthetic as chloroform or ether? To find an answer to this question we must examine, during and after anæsthesia, the subjective symptoms of which the patients complain and the condition of the different systems of the body.

I. Let us first consider the symptoms that occur *during* analgesis.

The puncture and the injection are not painful, and it is not necessary to begin by obtaining anæsthesia of the skin. The needle that I use is hardly any larger than that of a hypodermic syringe, and if we were obliged to use a local anæsthetic before making an injection of morphine I do not know where we should stop in that direction.

After the injection I have seen men and even children in about one case out of five show no disturbance either during or after the operation; the patients usually notice slight general distress and sometimes nausea or vomiting. The distress consists in numbness of the lower limbs, in a certain degree of respiratory anxiety, and in epigastric pressure manifesting itself in some cases by deeper and more profound breathing. During the analgesis the patients have a sensation of warmth and perspiration of the face and sometimes feel thirsty. This distress begins between the fifth and the eighth minute after the injection, lasts for about ten minutes, and is almost always over in a quarter of an hour.

Nausea occurs in two cases out of five; it is often preceded by pallor of the face. I have noticed that its frequency may depend on low tension of the spinal fluid. When at the moment of the puncture the liquid spurts out, there will be a minimum of disturbances from the use of the method; when the liquid flows out very slowly, indicating a low degree of tension, the analgesis will often be equally perfect, but more unpleasant for the patient. The dose used has also great importance, and with two and a half or three centigrammes nausea is much more frequent. Vomiting may in some cases begin five minutes after puncture, but, as a rule, it is not noticed until the tenth or fifteenth minute. It occurs in one case out of five, and is commoner in women than in men. It was of brief duration except in three of my patients, one of whom had taken eucaine. When vomiting comes on before or during an operation, no attention need be paid to it, or we can wait until it stops. It has no other importance than the annoyance which it occasions. Its cause is not yet clear, but it appears to be due to the alkaloid itself; it is certainly influenced by the condition of the digestive tube, as it is much commoner in urgency operations, when a patient has not been prepared beforehand.

Such are the disturbances of which the patients complain; let us now consider the condition of the different organs during anæsthesia.

The brain is not affected, nor is the spine above the regions that show analgesis. The lower limbs are numb and heavy; the patients do not attempt to make any movement, although perfectly able to do so. The sphincter ani is often completely relaxed. Sensation of contact remains, as well as that of heat and cold; sensation to pain is abolished. When the actual cautery is used during an operation, the patient feels that the instrument is warmer than a knife, but does not complain of the slightest pain. Power of motion is retained, but in the position of rest the muscles are completely relaxed, as under chloroform. Movements are less exact than in a normal condition; still, I have seen persons walk soon after an operation.

The pulse may not be modified, but usually it is quicker and soft. It has been experimentally shown that the method lowers arterial pressure, which is just the contrary to what happens when the drug is administered hypodermically. The cardiac rhythm is not

disturbed, but pulsations are more frequent; they oscillate about eighty, and may rise to one hundred and twenty. The breathing is not much affected by the method; inspiration is sometimes deeper and more ample, but the rhythm is normal. There is no hypersecretion or congestion, either in the bronchi or the parenchyma.

Besides the vomiting and thirst already mentioned, I have noticed in about one case out of twenty incontinence of flatulence, or even of fæces, which usually happens under the influence of a violent effort or sometimes after pressure on the rectum, as, for instance, during the removal of a retro-uterine tumor; in some cases semiliquid matter is discharged spontaneously. A lack of tone of the sphincter muscle is partly to blame for this occurrence, and it is probable that loss of sensation of the rectum acts in the same way; the reflex, which in a normal condition keeps the sphincter muscle tight, starts from the rectal mucous membrane; when the latter has lost sensation, the anus relaxes and allows the evacuation of the contents of the intestine.

The functions of the urinary tract are not modified. I have never seen incontinence of urine, and when I have had to use the catheter for therapeutic purposes, I have found the urethra without sensation, the membranous portion easy to traverse, and the bladder, whether healthy or diseased, also insensible both to contact and to distention.

II. The disturbances that may appear after analgesis will now be reviewed in the same order as above; that is to say, I shall successively consider the various subjective symptoms and the disorders of the various systems.

1. *Subjective Symptoms.*—During the day on which the operation is performed the patients are usually quiet, and their very satisfactory condition is one of the interesting results of the method. The feeling of thirst of which they speak at the end of the operation does not last for more than two or three hours, the distress disappears promptly, and as a general thing there is neither nausea nor vomiting. The face regains its color and animation, the pulse is normal and strong, the temperature oscillates about the normal, the bladder acts well, and the urine contains neither sugar nor albumen. Exceptionally there are, about four hours after the operation, two or three attacks of vomiting, but I have never known them to be either abundant or lasting.

Late in the afternoon or in the evening appears the most disagreeable and commonest symptom, headache, which occurs in about two cases out of five, but to a very varying degree. It usually begins six or eight hours after the operation, is felt in the forehead and occiput, has a congestive character, and is very similar to migraine; still, it is not accompanied by vomiting. It may last all night, but as a general thing it has disappeared by the following morning. In rare cases (about two per cent.) this symptom is very severe, and it may be two, three, or four days before it has entirely passed away. The different remedies that I have used have not been very successful. In my early cases I tried antipyrin, but it cannot be relied on. I frequently advise simple application of cold cloths to the forehead.

In addition to this early form of migraine, I have noticed in three cases a more tardy form. After from two to five days of perfect quiet, without the occurrence of the ordinary form of headache, the patients complain of migraine, particularly towards evening. This migraine is more troublesome than painful, but in one instance it was very severe and did not totally disappear for a week. Its pathogenesis is unknown; its causes are probably manifold. It does not always coincide with arterial hypotension, as do some forms of migraine. I have not been able to perceive a connection between it and any special condition of the digestive tract, nervous system, or kidneys, although I am convinced that some forms of headache depend on defective working of these organs. Nor is it accompanied by any symptom indicating functional disorder of the brain or spine. All that we know is that simple puncture of the lumbar region, with evacuation of ten, fifteen, or twenty cubic centimetres of liquid, without any injection whatever, may be followed by the same symptom. I have also observed that large doses of cocaine are more likely to be followed by headache, and that this symptom is equally likely to occur when eucaine or its derivatives are used. Thinking that the headache might be due to the cocaine remaining in the spinal liquid, I examined this with the help of two skilful chemists, and found that the cocaine disappears so quickly that no trace of it can be found by analysis even one hour after the injection. The possibility of a chemical irritation of the arachnoid membrane also occurred to me, but cytological examination and the test of the permeability to iodide showed that that membrane was perfectly sound. In four instances there was no trace of reaction

in the membrane, there were no cellular elements, and iodide did not pass into the liquid after the injection of cocaine. I shall, therefore, merely mention the frequency of this headache, give the assurance that it is not serious but only disagreeable, and note its clinical course; its explanation may be found later on.

2. *Disturbance in the Different Systems.*—The general nervous system is not affected in any way. The brain works perfectly, the ideas are clear, there is no agitation, and the only case of temporary delirium after the operation occurred in an alcoholic person. The spine is not affected either, sensation and motion of the legs are normal, and the faradaic reaction is intact. The reservoirs work well; in two cases after operations on the pelvis I had to use the catheter in the evening, but this is very common after such operations.

The circulatory system is not disturbed. The pulse is regular and regains its strength, arterial and venous circulation continues as usual, and the arterial pressure returns to its usual height. A rise in temperature is the only remarkable occurrence in the postoperative period. In my first cases it caused me some uneasiness. It is common, and is independent of the nature of the operation, it occurred as well after straightening of an ankylosis of traumatic origin as after a long operation with the knife. It does not generally exceed 37.8°, 38°, or 38.5° C. (from 100° to 102° F.), but it may reach 39° or 39.5° C. (102.2° or 103° F.). It has no connection with the intensity of other symptoms, and may appear in patients who have neither nausea nor headache. In exceptional cases it may be preceded by rigor, or merely by a feeling of chilliness; it is not accompanied by a specially rapid pulse, and with the exception of marked thirst it gives rise to no sign of fever. I have endeavored to estimate the frequency of its occurrence, which is about forty-five per cent., and especially its duration and evolution. In my last fifty cases I had the temperature taken every two hours during the first twenty-four. The mercury begins to rise in from four to six hours after analgesis; the maximum is reached in eight or ten hours, and in twelve or fourteen hours the temperature is again normal. The thermic cycle lasts, therefore, from six to eight hours, is a definite one, and is usually regular; however long other symptoms may linger, I have never seen this rise of temperature persist beyond twenty hours after the operation.

The cause of this symptom is very obscure. It is neither infection nor traumatic intoxication. I have endeavored to find out whether it is accompanied by those disturbances in the general condition which are habitual in infections. For this purpose I studied the modifications of the urine and of the hæmatic formula of operative cases for the same length of time. The urine of twenty-one patients was examined with regard to the amount of extractive matter, and the cryoscopic point was determined. The quantity of urea does not increase, there is neither sugar nor albumen, the freezing-point oscillates about the normal, and there is nothing that recalls the urinary formula of fever. The renal filter is not altered by this method of anæsthesia. The hæmatic formula of my cases has been studied by the head of my laboratory; the results obtained will be published separately, but I can now say that there is no modification similar to the leucocytosis of infection. On the other hand, the injection of water or serum into the lumbar portion of the spine does not cause a rise in temperature; it, therefore, seems that this symptom is due to the action of cocaine on the thermogenic centres. This post-operative rise of temperature is the most striking phenomenon; the respiratory apparatus is not affected, and I have not noticed any disorder in the pulmonary circulation, nor even bronchial congestion. The urinary system is not modified either; the kidneys work as usual, the bladder regains its usual power of contracting, and voluntary miction occurs in the afternoon and evening.

Such are the more or less disagreeable sensations, and the disturbances in the different systems, that accompany and follow this method of analgesis; but I have never seen them carried to such a point as to cause me any apprehension for the patient's life.

III. I have now performed two hundred and fifty-two operations according to this method, of which one hundred and forty-two were intraperitoneal and one hundred and ten extraperitoneal. Twenty-two of them were done in private practice; the others were witnessed by a great many surgeons, of whom a large number were foreigners. The operations which I have performed have been of the most varied character. For the sake of convenience they have been subdivided as follows:

Intraperitoneal:

Gastro-enterostomy	6
Gastrostomy	3
Entero-anastomosis	1
Artificial anus	3
Removal of the appendix, acute or chronic	22
Hernia, inguinal, crural, umbilical, or of the linea alba	42
Cholecystectomy	1
Incision and suture of hydatid cyst	1
Posterior colpotomy	7
Abdominal hysteropexy	5
Enucleation of fibroids (from one to seventeen) by the abdomen	12
Total abdominal hysterectomy	10
Vaginal hysterectomy	5
Laparotomy for adnexitis	10
Laparotomy for extra-uterine pregnancy	6
Laparotomy for ovarian cyst	4
Exploratory laparotomy, and for uterine cancer	3
Laparotomy for mesenteric cyst	1

Extraperitoneal:

Removal of breast for cancer	2
Colpo-perineorrhaphy	4
Extirpation of vaginal cyst	2
Operations on anus and rectum	17
Operations on scrotum and penis	14
Nephrotomy	3
Nephrectomy	2
Nephropexy	1
Bladder operations, tumors, calculi	7
Operations on the abdominal wall, fibroma, cyst, cancer of umbilicus	3
Osteoplastic operations on leg and thigh	9
Resection of knee	2
Suture of bones and of the patella	7
Various operations of the leg: arthrotomy, scraping of tubercular abscesses, removal of sarcoma, etc.	37

The youngest of my patients was ten years old and the oldest seventy-nine. Men bear this method of analgesis much better than women. Four patients had taken chloroform on a former occasion, and said that the new method was much less disagreeable. Finally, three of my patients who had to be operated on twice at a few days' interval bore the second injection of cocaine as well as they did the first.

I still think that this method is not applicable to children nor to hysterical patients. Children stand the use of cocaine very well,

and some of my patients ten or twelve years old were not upset by it in any way, but there are others who might be frightened. Hysterical patients, on the other hand, complain of the sensation of contact and interfere with the operator.

I think that patients with heart disease or arteriosclerosis have nothing to fear from the method, which I have used with a number of them.

In extraperitoneal operations—that is to say, all operations on the leg, hip, perineum, anus, rectum, vagina, uterus, testicles, prostate, bladder, ureter, and kidney—the operator can act with the greatest security. Analgesis by this method may fairly be placed by the side of general anæsthesia, and the future will show whether it is not to replace it. In operations on the lungs and pleura, in which the use of chloroform or ether has serious drawbacks, I think that preference should be given to this method when the operation concerns the lower two-thirds of the thorax.

As regards intraperitoneal operations, for the present I do not recommend the method to any but those who are fully accustomed to abdominal surgery. So long as no disturbance happens, and this is the rule, everything goes smoothly; but if any nausea or vomiting occurs, the operator may be hindered. He must then wait until the symptom passes, which is usually not long. This is the real drawback to the method, and it is sufficient to be taken into serious consideration. The simple operations, as for appendicitis, radical cure of hernia, and vaginal hysterectomy, a little nausea may make no difference; whereas in operations on the liver, stomach, or intestines, this is quite a different matter; so also long operations on the adnexa or uterus might in this way be interfered with. Although I succeeded in all cases of this nature and have never had any accident or incident capable of preventing or even hindering my operation, and although this form of vomiting is very rare, I do not feel authorized in advising other surgeons to copy me. I hope to find a way to avoid this drawback, and at present am engaged in researches to this effect.

Whatever may be the field that each surgeon shall assign to this method, I think that it will remain in practice by the side of local and general anæsthesia.

THE OXYTOCIC EFFECT OF THE LUMBAR INJECTION OF COCAINE, PARTICULARLY TO INDUCE LABOR.

BY A. DOLÉRIS, M.D.,

Accoucheur to the Paris Hospitals.

ANALGESIS of the uterus and of the genital zone, obtained during labor by means of the lumbar injection of cocaine, was the result expected in obstetrics from the ordinary action of this drug; it has, however, another action, equally remarkable and fortunate, which was not foreseen, as in the first instance, from the results reported by the surgeons. I am now referring to the *oxytocic action* of this alkaloid. The lumbar injection of cocaine increases the intensity, duration, and frequency of contraction, and possesses a power of stimulating uterine contraction which I have noticed in at least fifty cases of painless labor that I have observed up to the present time.

A mere hypothetical idea led me to look into the question of obstetrical analgesis. Actual observation has demonstrated to me the reality of the stimulating effect of cocaine on the uterine muscle. The phenomena noticed by physiologists concerning the action of this drug on the vessels and circulation find, therefore, a new corollary in the results of this farther experimentation.

I first called attention to these results in a paper read before the Academy of Medicine, and then in a more detailed report to the Obstetrical and Gynæcological Society, based on twenty-five cases. I then laid special stress on a fortunate consequence of the oxytocic action of cocaine, namely, the considerable decrease in the amount of blood lost at the moment of delivery, owing to a species of hæmostasis that occurs spontaneously. Close observation of the process led me to note also the state of tension of the uterine muscle following the injection in the lumbar region, and I pointed out the fact that this might be a counter-indication to performing internal version.

I naturally saw that the impression on the obstetrical world

might be unfavorable, owing to this special mention of increased uterine tension, and of more energetic, longer, and nearer contractions during a considerable length of time,—two hours or more. Still, several prominent facts were calculated to set these apprehensions at rest: the steady progress of labor, the suppleness of the cervix and its regular and quick dilatation, the normal condition of the fœtal circulation, and the perfect condition of the child until the end of labor.

At the present time, however, upward of one hundred concordant cases, due to three different persons, appear to show that all fear in this connection is unnecessary. Neither Kreis, Dupaigne, nor myself has noticed the slightest inconvenience connected with this false tetanus of the uterus, though this term seems to be a very strong one for the circumstances. I have repeated it here because it has been used in connection with these researches.

It should even be said that the extraction of a child by the feet by Smellie's process has been accomplished once by Kreis without harm. The difficult procedure, the seizure of the feet at the top of the uterus, which constitutes the first step in internal version, was not undertaken, and for this reason it is proper to make the same limitations in this connection that I made in my previous articles.

It seemed to me of real interest for the art of obstetrics to carry as far as possible a line of experiments that appeared to be likely to give useful results in the special direction of the oxytocic and hæmostatic action of cocaine, and this I was all the more willing to undertake since in all the articles that appeared at the same time as mine or later this purpose is not manifested by the writers, whether French or foreigners.

Up to the 8th of October last we had no other proof of the stimulating effect of cocaine on uterine contraction than the simple observation of the fact by towels and by the rapid progress of labor. By placing a hand on the abdomen the uterus is found to harden, and the duration of this phenomenon as compared with what was going on prior to the injection can be very readily noted. When nausea occurs, this reflex usually marks the beginning of the real oxytocic action of the drug.

If any other proof were needed, it could be found in the greater rapidity of labor, and especially in the rapidity of dilatation.

Kreis could not note the latter fact, as he always used the method after complete dilatation. Dupaigne noticed quick dilatation in the case of a primipara published in his paper. The increase in duration, strength, and frequency of uterine contraction is so evident that it seemed to me useless to have recourse to any of the self-registering apparatus, of which I had at one moment thought.

On the 8th of October I performed a Cæsarean section in a generally contracted pelvis, analgesis being effected with one and a half centigrammes of cocaine, and the result being as satisfactory as possible. The condition of the uterus during the operation was as follows: the upper part of the incision fell on the placenta, which was inserted on the fundus, while the lower part extended somewhat onto the inferior segment. As soon as the uterus was opened and evacuated, it hardened in a remarkable fashion and remained hard and contracted for the length of time required to put in the sutures. Perfect hæmostasis could have been obtained without the constrictor, which was purposely applied rather loose. It can be said that the patient lost extremely little blood, and this was the impression of all who saw the operation.

This was a visible proof and undeniable demonstration of the oxytocic and analgesic effect of the cocaine injection. Never during the Cæsarean sections that I previously performed had I seen such steady and satisfactory uterine contraction.

I now come to another order of facts, connected with uterine inertia during labor. Although in the majority of my cases, of which some are published and others not, while seeking particularly for the analgesic effect of cocaine, I obtained the additional benefit of its oxytocic action, which I had not expected and which did not seem necessary, there is a group of cases in which, as the sluggishness of the uterine muscle appeared likely to prolong labor unnecessarily, I employed the cocaine method for the purpose of stimulating contraction.

I am in a position to state positively from these facts that, whenever uterine contraction becomes sluggish and short and occurs at long intervals, an injection of one centigramme of cocaine is sufficient to produce remarkable stimulation of the uterus. This stimulating action manifests itself not only when contractions are weak and far apart, but also when during labor they have stopped altogether, as in the well-known phenomenon called uterine inertia.

I was naturally led to wonder whether this power of stimulating uterine contraction, observed during normal labor or when it is pathologic through inertia, would appear equally well when labor had not begun. The exact point to be determined was whether the lumbar injection of cocaine has the power of bringing on uterine contractions without their having previously existed. Some observations led us to think so.

During a certain number of curettages that I have performed for retention of the placenta, with the lumbar injection, I noticed that the uterus, which was inert at first, contracted on the Hegar dilators. The stimulating contact produced by a voluminous foreign body like a metallic dilator might have explained these contractions, although they do not usually occur during curettage, with or without chloroform anæsthesia; but the contraction took place equally well on the hysterometer or curette when these instruments were simply allowed to lie motionless in the uterine cavity.

On putting these facts together, it seemed likely that labor or abortion could be produced by means of the lumbar injection of an amount of cocaine to be ascertained, and this hypothesis has been fully confirmed; in two cases in which premature confinement was indicated for different reasons, it was brought on with the small dose of one centigramme of cocaine.

The first patient was a woman with a seven months' fœtus, dead and macerated, who had been sent to our wards from a house of refuge, with the exact diagnosis, but whom we kept under observation for three weeks as a measure of prudence. Labor began suddenly by the very energetic contraction of a uterus that had been flabby and inert for about a month, fifteen minutes after the injection. During an hour and three-quarters the contractions followed one after another regularly and in close succession, without causing pain. The cervix, long and closed, became effaced, and dilated rapidly to the dimensions of a five-franc piece. From the moment when the analgesis disappeared, the contractions became less frequent and assumed the character that is customary in normal labor, which shows once more the oxytocic effect of cocaine following a corresponding course to its analgesic action. Labor thus begun went regularly on, and spontaneous delivery took place in six hours and twenty minutes. The relatively short time in which this was accomplished will be appreciated when we remember how slow

and difficult the dilatation is in these cases of macerated fœtus, where there is no accommodation to the pelvis and no water tension, both being incapable of bringing any regular and energetic pressure to bear so as to hasten the disappearance and dilatation of the cervix.

In the second case labor began more quickly. The patient was a consumptive in the last stages, short of breath, cachectic, very weak, and likely to die before her confinement; she had had a number of children, and the present pregnancy was eight months and one week gone, with a living child. Nine minutes after the injection the uterine muscle contracted energetically for a minute and a half, and from that time on contractions took place regularly every three minutes up to delivery, which occurred in four hours and thirty-five minutes.

Encouraged by these two successful cases, I tried to effect by the same method the evacuation of the uterus in a case of retention of the placenta. The choice of this first case might have been a better one, since the retention had already lasted three days and the cervix had reformed to about an inch in length. Although the purpose was not attained, the phenomena observed were at any rate interesting to note, and allow me to hope that in cases of retention of recent occurrence we shall be able to bring about the spontaneous ejection of the placenta.

The results of the foregoing observations may be summed up as follows: 1. The lumbar injection of cocaine is counter-indicated with pregnant women; if the method were used for the execution of any operation during pregnancy, miscarriage might ensue. 2. A new method of bringing on labor has been found in the use of these injections, which have a certain effect on the uterine motor nerves. 3. This process may render great service in case of uterine inertia during labor, particularly with a moderately contracted pelvis, as I have found in two instances. 4. In eclampsia, where rapid evacuation of the uterus is indicated, the lumbar injection ought to be efficacious, and may have a happy effect on the nervous reflex symptoms.

THE TREATMENT OF PUERPERAL ECLAMPSIA BY SALINE DIURETIC INFUSION, BASED ON TWENTY-TWO CASES.

BY ROBERT JARDINE, M.D. (Edin.), M.R.C.S. (Eng.), F.F.P. AND S. (Glasg.),

Physician to the Glasgow Maternity Hospital; Examiner in Midwifery to the University of Glasgow; President of the Glasgow Obstetrical and Gynæcological Society.

WITH the exception of concealed accidental hemorrhage and rupture of the uterus there is no more fatal complication of parturition than puerperal eclampsia. From the days of Hippocrates down to the present, innumerable treatises have been written on it, and yet we must sorrowfully confess that there is still a great deal for us to learn, especially as to the causation of the fits. While we have to admit that we are still ignorant of the exact cause, we have reason to congratulate ourselves on the fact that we are now able to treat the condition with much greater success than the older obstetricians could. Its death-rate of something like fifty per cent. has now been reduced to below twenty; but it is still a complication much to be dreaded, and when it occurs the treatment must be prompt and energetic if the patient is to be saved.

Before the beginning of the nineteenth century very little advance was made in the study of the disease. Hamilton and Demanet were the first to point out the frequency of œdema in these cases, and Hamilton and others also noticed that intense headache and amaurosis were often present. The presence of albumin in the urine, especially in dropsical cases, was first pointed out by Sir James Simpson and Lever. Before this the cause was looked for in the brain, but attention was then directed to the kidneys and new theories of causation were brought forward. Many hypotheses have since been advanced, but none of them is satisfactory.

I shall not attempt to add a new theory, but shall merely indicate what our knowledge of the condition amounts to at present. Pregnancy, while it may be said to be a physiological condition,

certainly throws a tremendous strain upon a woman, especially upon her excretory functions. The organs have to do double work, so to speak, and if any of them fail the results are likely to be disastrous. In many cases the nervous system is in a very unstable condition. This is probably because the nerve-centres are not properly nourished by the hydræmic blood of pregnancy. The unstable condition of the nervous system is very much like that of infancy. Given an irritable condition of the nerve-centres, any noxious substance retained in the blood will be very apt to cause an explosion. What the substance is or where it originates we do not know. An attempt has been made to prove that a micro-organism is at the bottom of the mischief, but so far the bacillus has not been found. I am inclined to think that the toxine is a chemical substance, the result of tissue metabolism in connection with the development and nourishment of the fœtus *in utero,* which should have been cleared out of the woman's system by her excretory organs, especially by the kidneys. There can be no doubt that the kidneys are at fault. The excretion of urine is often almost entirely suppressed, in very many cases the urine has more or less blood in it, while albumin is practically always present. These facts all go to show that the kidneys are for the time being practically useless as excretory organs. It is well known that a pregnant woman with bad albuminuria can be saved from convulsions provided suitable treatment is adopted to get her kidneys to act freely.

The liver seems to be involved, but in what way I am not prepared to say. It is frequently found to be degenerated. In one of my patients death was due to a perforating duodenal ulcer. The patient was apparently cured of her eclampsia, as her urine had cleared up and she was quite conscious, when, on the seventh day, she suddenly collapsed, without any warning. The abdomen became tremendously distended, and she died in a few hours. The post-mortem examination revealed a large perforating duodenal ulcer exactly opposite the opening of the bile-duct. There were no adhesions, so the ulcer must have been of recent origin. She had never complained of any epigastric pain previous to or during the stay in hospital. Did this ulcer originate in the same way as one after an extensive superficial burn? It looked as if some noxious substance secreted by the liver had destroyed the portion of the duodenum against which it had flowed from the bile-duct.

What effect, if any, has the condition on the fœtus *in utero?* If there is a poison circulating through the woman's system, the fœtus is sure to be affected through the placenta. There can be no doubt that this is the case. Very often the child is killed by the poison. The fœtus has been observed to have convulsions *in utero,* and in a good many cases has been delivered dead and rigid, as if it had died in a convulsion and remained rigid. I have delivered two children in this condition. If the child is born alive, it may have convulsions of exactly the same nature as the mother's. I have seen several such cases. Children born during eclamptic seizures are said to be much more prone to convulsions during infancy than other children. The kidneys of the fœtus are affected in the same way as those of the mother. Sir James Simpson was the first to point out that the urine of the child contained albumin. In every case examined I have found a considerable amount of albumin present in the child's urine, and quite recently have found the same in the urine of two children whose mothers were very dropsical, with large amounts of albumin in the urine, but who were saved from convulsions by prompt and energetic treatment.

It has been asserted that on the death of the fœtus *in utero* the albumin very quickly disappears from the mother's urine. I cannot endorse that statement, because in two of my cases the fœtus had been dead long enough to be quite macerated and yet the urine was albuminous, in one case becoming nearly solid on boiling.

The method of treatment which I am about to describe is one which I have been using for three years, both in the Glasgow Maternity Hospital and in my private work. It is based on the assumption that there is a toxic substance circulating through the woman's system. If we knew what that substance is, we would probably very soon find an antidote to counteract its action; but, as we are ignorant of its composition, our only hope is to free the system from it as quickly as possible. Now, how may this be best accomplished?

There are three main channels through which poisons may be eliminated from the blood,—viz., through the skin, the bowels, and the kidneys. The importance of getting these channels to act well has long been recognized in the treatment of the condition. This is easy enough if we have time. We can give appropriate drugs by the mouth if there is time enough for them to act. During the last month I have had half a dozen cases of dropsy with marked

albuminuria in patients nearly at full time. Most of them had severe headaches, so that one felt justified in saying that they were on the verge of eclampsia. They were promptly purged with Epsom salt and given large doses of acetate and citrate of potash along with milk diet and imperial drink. They were all saved from eclampsia, with one exception (Case III.), and in her case the time was too short to establish the action of the drugs by the mouth. She was in labor when first seen. All the others were well under treatment before labor began.

How can we best act through the different channels when the patient is actually convulsed.

The best way to act upon the skin is either by hot packs or a vapor bath. The hot blankets must be well wrung out or the skin may be blistered. For the same reason a hot-water-bottle must not be allowed to touch the bare skin. The hot pack may be repeated when necessary. The pulse must be watched. Pilocarpine has been and is still used, but it is exceedingly dangerous. If there is any œdema of the lungs, and there is in nearly every case, pilocarpine will increase it tremendously, and the patient may be actually drowned by the mucus in her bronchial tubes, for which reason I have never used it.

To act on the bowels is not always easy. If a good hypodermic purgative could be manufactured, it would be most useful in such cases. Croton oil is generally recommended. I have tried it in doses of five minims without any effect whatever. I have twice seen bad œdema glottidis in cases in which it was used. The purgative that I depend most upon is Epsom salt, giving not less than one ounce at a time and very often two. If the patient is quite unconscious, it is poured into the stomach through a tube. Enemata are useful to unload the rectum and also to start the action of the bowels later on.

The kidneys are the organs of excretion which are most at fault, and it is of the utmost importance to get them to act as promptly and freely as possible. Before the fits come on, if there is time, the administration of diuretics by the mouth is generally all that is necessary; but when the convulsions are present there is no time to wait, the patient is generally not in a condition to swallow freely, and absorption is largely in abeyance. It is with the idea of flushing the kidneys freely that I have been giving copious infusions

containing, besides the normal saline solution, large doses of either bicarbonate of potash or acetate of soda. Bicarbonate of potash or any potash salt is a powerful poison when introduced directly into the blood, but I cannot say that I have ever seen any poisonous effect from it when introduced into the cellular tissues. I used at first one-third and latterly one-half drachm of it to each pint. The acetate of soda is non-poisonous; hence much larger doses of it can be used. One drachm to the pint is the solution I am now using. We have never been able to collect all the urine excreted, as in every case the bowels have been acting freely, but I am firmly convinced that there is a prompt diuretic action. The large quantity of fluid alone would help this, but I am certain that there is a greater effect than when only normal saline solution is used. Is there any other beneficial effect from the solution? In cases of septicæmia repeated injections of normal saline solution have a very beneficial effect. The diluting of the poison in the system may be the true explanation, but the solution also acts as a powerful stimulant, as is seen in cases of severe shock when treated in this way. In eclampsia we also have the marked diluting of the poison and the stimulating effect. The pulse is very quickly improved.

The apparatus required is very simple,—viz., a medium-sized trocar and canula, as supplied in Potain's aspirator, a few feet of tubing, and a funnel. Messrs. Gardner, of Edinburgh, have fitted up a very convenient apparatus in a metal case. Messrs. Burrough, Welcome & Co. have made up, at my request, soloids of sodium chloride and sodium acetate,—a drachm in each. Boiled water should be used at a temperature of about 104° F. The apparatus should be sterilized by boiling.

The solution may be run into any part of the body where the tissues are loose, but under the breast, the right preferably, is the most convenient situation before delivery. After delivery the lax abdominal wall does admirably. The skin should be thoroughly cleaned before making the puncture. The trocar and canula should be thrust beneath the breast and not into the mammary tissue. If the solution does not run in at once, the end of the canula must be lying against firm tissue; so it should be withdrawn a little and moved about until it is clear. If the tissues are at all lax, a pint may be introduced in about five minutes. I have given one in four minutes. A pint can be easily run under any breast, and I have

often put in three pints. A very large swelling forms, which for a time is rather painful from the tension; but absorption is so rapid that the pain quickly subsides. If the solution has been put into the axilla, the pressure upon the large nerve-trunks is apt to cause a good deal of discomfort.

It may be asked whether there is not risk of destroying the breast by putting so much fluid under it. There certainly is if strict aseptic precautions are not taken. I have never yet had the slightest trouble with any of my cases, although I must have given over two hundred infusions. I have heard of suppuration occurring, and it will be very apt to ensue in careless hands. The puncture should be covered with strips of rubber plaster. Absorption begins at once; within an hour it will be complete. The urine excreted after the infusion is usually heavily loaded with urates. A quantitative analysis made in a number of cases showed that the percentages of urea and uric acid were both very much increased immediately after the infusion. If the patient does not improve in a few hours, another infusion can be given. As soon as the patient is able to swallow, she should take large quantities of imperial drink and milk. If the pulse is very weak, stimulants should be freely administered.

For controlling the fits I have used various remedies,—viz., chloroform, chloral, bromide, veratrum viride tincture,[1] and morphia. In a few cases nothing was used except the infusions, purgatives, and hot packs. If the pulse is very tense, a hypodermic injection of from ten to fifteen minims of tincture of veratrum viride seems to be the best treatment. I have used morphia freely, but have given it up, as it seems to me to lessen the excretion of urine. In one patient whom I saw under the care of another physician the pupils contracted to the size of a pin's point and she died with complete suppression of urine; it looked exactly like a death from morphia poisoning. In our hands morphia has never given the good results which others have claimed for it.

Bleeding has occasionally been resorted to, and it is a method of treatment which I would unhesitatingly adopt in suitable cases, but our hospital patients, drawn as they are from the poorer parts

[1] It should be remembered that the tincture of veratrum viride of the United States Pharmacopœia is very much stronger than that of the British.—Ed.

of a great city, are seldom of the plethoric type. It is a method of treatment which should do exceedingly well when combined with large infusions. Post-partum bleeding is always encouraged, but I have rarely seen an active post-partum hemorrhage occur. In bad cases the blood which comes is generally very dark in color.

As to the obstetric treatment each case must, of course, be judged on its own merits, but, broadly speaking, the less interference with the uterus the better in convulsions which occur before labor begins. In several of our cases we have relieved the patient and she has had a perfectly natural parturition some days later. If the fits cannot be controlled, the uterus should be emptied by rapid dilatation with the patient deeply under chloroform to avoid shock as much as possible. If the cervix is difficult to dilate, it should be freely incised, and, if necessary, the incisions should be stitched after delivery. Any bleeding which occurs will be beneficial. Cæsarean section has been advocated and practised in such cases, but a fifty per cent. death-rate does not commend it, especially when one can deliver as quickly by incising the cervix. In cases where the os is fully dilated or quite dilatable the patient should be delivered at once.

The method of treatment just described is the one which we have been carrying out in the Glasgow Maternity Hospital for the last three years. It differs from the older methods only by the addition of the diuretic infusions. We have now treated a sufficient number of cases to compare the two methods. In the next issue of The Glasgow Hospital Reports Dr. Kerr, one of the assistants to the hospital, will publish a paper based on all the eclampsia cases treated in the hospital during the last fifteen years. The death-rate under the old method of treatment was forty-seven per cent. This is a very high mortality, but it must be remembered that a large number of the patients are sent in after they have been having convulsions for many hours. Some of them are practically moribund when admitted. Since we have been giving the saline infusions the death-rate has fallen to twenty-four per cent. This shows a very remarkable decrease in the number of deaths. The patients have been sent to us in the same condition as in former years, so that the results cannot be explained by saying that we have only been admitting mild cases. We did not select them, but took them as they came. Some of them were hopeless, and I do not think that any treatment

could possibly have saved them. During the year in which I began the treatment we admitted eight patients and five of them died. The remaining three were cured, and they were the only ones to whom the infusions were administered.

I shall now give full notes of three typical cases; my colleague has also had a good many, and his results have been equally good. Case III. is the only one which has occurred in my private practice.

Case I.—An unmarried primipara, aged nineteen, seven months pregnant. She was sent to the hospital by her medical attendant. She had had fourteen fits and was semi-comatose. There was slight œdema of the feet. Her pulse was 130 and thready. The os was beginning to dilate. The urine was heavily loaded with albumin.

At 2 A.M. thirty ounces of saline (thirty grains each of potassium bicarbonate and sodium chloride to the pint) were injected into the right inframammary region and a large dose of calomel and jalap was given. She was put into a hot pack, but did not sweat at all. In two hours' time the os was fully dilated and she was delivered with Milne Murray's forceps. The fœtus was beginning to macerate. After delivery twenty-four ounces more of saline were injected into the left axillary tissues.

She remained semi-comatose for nearly two days. She could be roused and got to drink, but would not answer when spoken to. When she became conscious, she said she had no recollection of anything since two days before the seizure. In the first twenty-four hours she passed thirty ounces of urine and five motions; in the second, ninety ounces and two motions; in the third, one hundred and forty-five ounces and one motion; in the fourth, eighty-three ounces.

Her recovery was uneventful. She had no fits after admission. The urine was free from albumin when she was dismissed on the tenth day.

The urine was examined by Dr. Carstairs Douglas, and the following is his report. (1) Urine before injection was opaque, light yellow, highly turbid from urates; albumin abundant; urea not estimated, owing to smallness of amount; uric acid 0.101 per cent. (distinctly above the average). (2) Urine shortly after injection was opaque, light yellow, fluid, loaded with urates and albumin, moderately acid; no blood, bile, or acetone; turned Feh-

ling's solution reddish purple, but did not reduce it; urea 1.6 per cent. (rather low, especially as urine was concentrated); uric acid 0.112 per cent. (3) The urine twenty-four hours later is almost clear amber, acid, with a trace of albumin; has no effect on Fehling's solution; urea 2.4 per cent. (distinct rise); uric acid 0.0217 per cent. (marked fall below the average).

In this case nothing was given to control the fits. It will be noted that the urine was loaded with albumin although the fœtus was macerated.

Case II.—Mrs. B., aged twenty, in the sixth month of her second pregnancy, was admitted on January 12, at 11.45 p.m. For two days previous she had had a violent headache and some sickness. Convulsions had come on in the evening, and she had had six fits at the time of admission. Her face was puffy, but there was no marked œdema. She was semi-comatose. A catheter specimen of her urine became quite solid on boiling. The os admitted one finger.

She was given a large dose of salts, ten grains of chloral hydrate hypodermically, two pints of saline infusion (one drachm each of acetate and chloride of sodium to the pint), and a hot pack. As the fits continued, I cleared the uterus by *accouchement forcé*. The hot pack and chloral were repeated. Free diuresis was quickly established and the bowels acted well.

The fits continued until the evening of the 13th,—that is, for about twenty-four hours. She had in all twenty-eight,—ten before and eighteen after delivery. At noon on the 13th I gave her two pints of the infusion and ten minims of tincture of veratrum viride hypodermically. During the next few days she was very stupid, but could be roused. She was passing plenty of urine and the bowels were acting freely. The arm into which the chloral had been injected became inflamed, but hot boracic applications soon relieved this. By the 16th she was quite conscious. The albumin had almost entirely disappeared.

Early on the morning of the 17th she became deeply comatose, and remained so the whole day. Dr. Oliphant saw her with me in consultation, and we gave up hopes of saving her. About 10 p.m. we fed her with meat juice, brandy, and milk through a tube, gave her two pints of infusion and ten minims of tincture of veratrum viride. At 2 and 9 a.m. on the 18th she was again fed through the

tube. The coma had now lessened, and by the 19th her mind was quite clear.

After that she made an uninterrupted recovery. The urine drawn off during the second attack of coma was loaded with bile-pigment, but there was very little albumin in it. She was excreting large quantities.

The second attack of coma and the excretion of large quantities of bile-pigment in the urine are both noteworthy features of this case. It seems as if the liver were in same way connected with this second attack of coma. By that time the kidneys were practically all right and doing full work.

Case III.—Mrs. B., primipara, aged twenty-three, full time. Her health during the pregnancy had been very good except during the last few days, when her feet, legs, and face had become swollen. She had not slept well for several nights. Labor began early on the 30th. From its onset she had noticed that her urine was very high colored. Severe headache had come on. In the evening, when I saw her, I found there was marked œdema of her face, legs, and feet, and the urine was heavily loaded with blood. It became almost solid on boiling. As the os was dilated, I gave her chloroform and delivered with forceps. The child was dead. After she came out of the anæsthesia she said that her headache was relieved.

She was put on milk diet, given an ounce of salts, imperial drink, and chloral and bromide. Twelve hours after delivery she had a slight fit, and two hours later two very severe ones in rapid succession. I gave her chloroform and infused one and a half pints of saline under her right breast. As there was no perfectly pure sodium chloride at hand, I used three drachms of the acetate alone. She was put into a hot pack. As soon as she could drink, another ounce of salts was given. The bowels had moved only once. Three hours later she had two more fits, when fifteen minims of veratrum viride tincture were given and ten minims more an hour later. It had no appreciable effect on the pulse. The hot pack was repeated. The bowels soon began to move freely. Her pulse was very weak; so she was freely stimulated with whiskey. In the evening the temperature was 103° F. She was excreting large quantities of urine, but it was heavily loaded with blood, which did not disappear from it until the fourth day, and she did not regain full consciousness until then. During this time her temperature ranged

between 101° and 103° F., and after that it fell to normal. In nearly every case we had high temperatures for a few days.

If I ever have a similar case, I shall certainly give a large infusion at once and not trust to diuretics by the mouth. If this patient had been under treatment for a few days before delivery, in all probability the fits could have been prevented. Unfortunately, she did not send for assistance then, although warned to do so.

It should be a routine practice to examine the urine of every primiparous patient a few times during the last two months of pregnancy. I do this as far as possible, but it is not always easy with working-class patients. I try to impress upon all patients that they should let me know if there is any swelling of the feet and legs, and especially if they are troubled with headaches, during the last two months of pregnancy.

At present I have under observation an elderly primipara, nearing full time, whose urine three weeks ago was nearly solid with albumin, which under prompt treatment has now disappeared, and she will probably escape eclampsia. If she had not been treated, there is little doubt that convulsions would have come on in a very few days. Prevention is always better than cure.

An analysis of these three cases and nineteen others treated by me in the hospital shows that seventeen were primiparous and five multiparous. One-half of the labors were at full time and in only one case did the fits begin during the puerperium. Thirteen of the children were born dead and ten alive, there being a case of twins among the latter. Of the dead children two were macerated, three were delivered by craniotomy, and three were too premature to live, so that of the twenty-three children only five were lost which might possibly have been saved. Of those born alive one was premature and lived only two hours.

Of the twenty-two mothers three died, but one of the deaths was due to a perforating duodenal ulcer after recovery from the eclampsia. Even counting that as a fatal case, three deaths in twenty-two, or 13.64 per cent., is certainly a very low death-rate. Considering that one of the other fatal cases had double pneumonia, multiple ulcers in the stomach, and patches of congestion throughout the intestines, one cannot wonder that she died. I thought the other fatal case would have recovered, but probably the degenerated

condition of her liver accounted for the failure of the treatment. In both these cases craniotomy was necessary, showing that they were difficult from an obstetric point of view, especially the last one, in which there was marked contraction of the pelvis.

The results to both mother and children are exceedingly good. Not a single case could have been called a mild one and some of them appeared hopeless; in fact, several of the successful ones had been actually given up by the medical men who sent them to us. From a very large experience in the treatment of eclampsia by many methods, I have no hesitation in stating that in my hands the saline diuretic infusions have given by far the best results. I leave the cases to speak for themselves.

THE TREATMENT OF MALIGNANT TUMORS BY AN ANTICELLULAR SERUM.

BY DR. WLAEFF,

Privat-docent of the Academy of Medicine of St. Petersburg.

THE anticellular serum obtained by me at the Pasteur Institute, where for two years I have experimented on animals with injections of the pathogenic blastomycetes isolated from human malignant tumors, has been used by me so far in twenty-six patients, who can be divided into three categories,—(1) patients with malignant tumors, ulcerated or non-ulcerated; (2) those suitable for operation, or otherwise; (3) those with generalized or localized tumors. Whenever possible I made a microscopical examination of the juice and of particles of the tumors before beginning the treatment, and in both I almost always found, among other microbes, the one mentioned above. I inject from seven to fifteen cubic centimetres of serum, the amount varying with its strength; and experience has shown that the injection should not be made in the tumor itself. I make an injection every five to eight days, and the serum should be taken from geese that have been rendered immune during a period of time ranging from eight to twelve months. All of my patients were examined and followed by some of the best-known practitioners of the Paris hospitals, both physicians and surgeons.

Ulcerated Cancer of the Lip.—The first patient I treated by a very weak anticellular serum, taken from geese that had been rendered immune for only two months. He had an ulcerated cancer of almost the entire lower lip, and the submaxillary ganglia as well as those of the axilla were enlarged. After two injections I found that the tumor had decreased in volume, the ulceration had begun to heal in places, the general condition and appetite had improved, and the patient felt stronger. When this man had received four injections, I ran out of serum for two weeks, during which time he remained without treatment. Seeing that the tumor was beginning to increase in size again, M. Reynier, in whose ward he was, decided

to operate. The wound healed up satisfactorily, but two months later a new ulceration appeared on the cicatrix and increased rapidly in size, the submaxillary ganglia on the left being enlarged. After four injections the ulcerations disappeared completely and the ganglia decreased in size. This was in April, and the patient then remained four months without treatment, during which time one of the ganglia became as large as a hazel-nut. I then made two injections in ten days, and this was followed by another interval of five weeks without treatment, the ganglion in this time increasing noticeably in size. On September 24 another injection was made, and on the following day the ganglion was found to be smaller. The weight of the patient increased one pound in one week. He was then operated on a second time, and is still under observation.

The second patient of this class had an ulcerated tumor of the lower lip that dated back four months. After four injections of the serum the tumor has begun to heal and diminish in size.

Malignant, Non-ulcerated Tumors of the Breast.—I have treated four patients of this class, two of them suitable for operation and two of them not. One of the latter, who was in M. Richelot's ward, became suitable for operation after receiving four injections. Her tumor, which was in the left breast and non-ulcerated, was exceedingly large, the axilla on the same side being likewise filled with a huge mass. Owing to the great size of these tumors the skin was so much stretched that it was impossible to define their limits, and the patient was thought to be beyond the reach of surgery. M. Richelot then decided to try the injections, after two of which the patient gained two pounds in weight in two weeks. After four injections the tumor and the mass in the axilla had manifestly decreased in size and their limits could now be defined. The patient then underwent operation. Microscopical examination showed the growth to be an epithelioma.

The other non-operable patient had already undergone two operations in a year and a half in M. Berger's ward; a third was now refused to her, as the ganglia of her neck were affected. She is now undergoing treatment with the anticellular serum and has improved: the tumor and the ganglia have decreased in size, while the patient eats and sleeps better and feels much stronger.

One of the two patients suitable for surgery was operated on after two injections by M. Reynier. She had a non-ulcerated tumor

of the breast the size of a goose-egg, with several glands in the axilla. These tumors were found to be all encapsulated, and the microscope showed the tissue to be epithelioma.

The other patient suitable for operation was also in M. Reynier's wards. She had in the right breast a non-ulcerated tumor of the size of a large walnut, with ganglia in the axilla as large as hazel-nuts. She was so weak that she could no longer work nor even walk. After the injections the tumor decreased little by little until it was no larger than a hazel-nut, while the ganglia returned to their normal size. After five months' treatment the patient's strength had increased, she had gained eight pounds in weight, felt well, worked, walked, and travelled, and her condition was very satisfactory. She was also seen by MM. Berger and Lucas-Championnière. She was finally operated on by M. Reynier, and the microscope showed a typical epithelioma.

Ulcerated Malignant Tumors of the Breast.—I have treated two cases of this sort at a very advanced stage. One of these patients, who was in M. Reynier's ward, had an enormous, ulcerated tumor of the left breast, which had spread to the ganglia of the axilla and clavicle. The patient was very thin and worn out, and was, in addition, suffering from consumption. After one injection the tumor broke down and formed a cyst, which then emptied itself little by little. The general condition improved slightly.

The other patient of this class, with an ulcerated sarcoma of the breast, had already undergone several operations, but the tumor had then begun to make such rapid progress that all the ganglia (axilla, groin, neck, and bronchi) were affected. Where the breast had been removed there was a large ulceration, and there was a second smaller one on the sternum. The patient could no longer sleep, on account of the pain in the shoulder, arm, and head, and she was extremely thin. After the first two injections the pains disappeared and the ganglia decreased in size. The ulcerations were only half as extensive and began to heal. Sleep and strength came back little by little. After seven injections the patient's condition had so much improved that she left for the country, having gained five pounds in weight. One week, however, after the last injection, she noticed that the left side of her face, as well as her left arm, were beginning to swell, and when I saw her a week later there were swelling and cyanosis of the face, the pains had reappeared, and the patient was breathing with

difficulty, symptoms due, no doubt, to enlargement of lymphatic ganglia invaded by morbid tissue. I began the treatment again, and twenty-four hours after the injection the swelling decreased, the pain in the back and neck disappeared, while that in the arm diminished. Her condition then improved, she became stronger, appetite increased, and the ganglia grew smaller. She is still under treatment and has received ten injections so far.

Cancer of the Rectum.—I have treated three patients with this disorder, all of whom were examined before and during treatment by M. Berger. One of them had been operated on two years previously, an artificial anus having been created in the iliac region. All three patients bled freely on going to stool. During their treatment by the anticellular serum these losses of blood ceased completely in two patients and decreased very noticeably in the third. In one case fecal matter mixed with blood came away continually before the treatment; at the present time this fecal incontinence has disappeared, the patient having four or five motions in the twenty-four hours, without any loss of blood. His weight remains stationary, whereas previously it was steadily decreasing. Before the treatment he could neither work nor even walk, owing to weakness and rectal incontinence; now he can work, can take long walks, and is much stronger. He has had ten injections in three months, and has been shown to M. Lucas-Championnière.

Each of the other two patients of this class has had nine injections. There is considerable improvement, both in the general and the local condition, in all three patients; they are all stronger and their appetite has improved.

Cancer of the Tongue.—I have had six patients with this disorder; in five cases the tumor was ulcerated; in four of the latter the submaxillary and cervical ganglia were so enlarged that the patients could neither eat nor sleep, and the suffering prevented their getting any rest.

In the sixth patient of this series the tongue was so enlarged that it filled the entire mouth and he could neither eat nor speak distinctly. There was also profuse ptyalism and the pain prevented him from sleeping. After fifteen injections his tongue had noticeably decreased in size, salivation had almost disappeared, he began to speak distinctly, and his suffering had almost ceased. During the four months in which he was being treated he did not lose weight. He

has now been lost sight of, but he was examined a number of times by M. Reynier and shown to the members of the Academy.

One of these patients had an ulcerated tumor of the size of a walnut on the left side of the tongue and a second one of the size of a hazel-nut in the palate. All the ganglia of the left side were diseased, but after two injections they decreased so much in size that the circumference of the neck was visibly smaller. This patient has received thirty injection in six months, and his weight has not changed during that time. He lives in the country and comes every week for an injection. The tumor of the tongue has decreased in size and has nearly healed; that of the palate appears granular. It cannot be said that he is cured, but during the past six months the disorder has not only not increased but has distinctly diminished. This patient was examined by MM. Reynier, Fournier, Berger, Lucas-Championnière, and others.

Another of these patients, fifty-one years of age, had been suffering for a year. His tongue was enlarged and ulcerated in several places; there were adhesions with the palate, and two tumors at the base of the tongue, one of the size of a walnut and the other of a hazel-nut. The ganglia of the right side formed a mass as large as an egg and those of the left side were of the size of a walnut. The patient's mouth exhaled a dreadful odor. He had also a tumor of the left thigh, two inches below the groin, the size of an egg. He had constant headache and pain in the tongue and ears. He could not even swallow milk: when he tried to do so, it came back by the nose. His condition was so deplorable that he talked of suicide. His weight had decreased progressively from one hundred and twenty to seventy-eight kilogrammes. After the second injection pain disappeared completely, the ganglia and tumors decreased, the patient began to swallow not only liquids but soft-boiled eggs, and his speech became more distinct. He now feels stronger and sleeps all night as well as several hours during the day. Little by little the ulcerations have healed; the ganglia of the left side have become normal, whereas those of the right are the size of a hazel-nut and only slightly painful. The tumors at the base of the tongue have almost disappeared, though the organ is indurated in places. The adhesions of the right side still exist, but the movements of the tongue are freer and the patient can speak and whistle. The tumor of the groin broke down, gave issue to a creamy substance, and is

now no larger than a hazel-nut. This patient received twenty injections in four months; he increased two pounds at the beginning, and has kept this weight since. He was under the observation of M. Berger and was shown to M. Lucas-Championnière.

Another one of these patients in M. Berger's ward, sixty-four years of age, had an epithelioma larger than a walnut occupying the whole left base of the tongue. The ganglia on the right side were as large as an egg, those on the left as large as a hazel-nut. The disorder was first noticed three months previously. Patient could neither speak distinctly nor even swallow liquids; he had pain in his tongue, mouth, and neck, and had lost a great deal in weight. After the very first injection he was able to swallow not only liquids but also bread and eggs, while the pain decreased noticeably, the tumor and ganglia were smaller, his articulation was clearer, and he gained two pounds in a week. He received ten injections in two months and a half, and gained another pound. His strength returned and he began to work again. The ganglia of the right side were no larger than a small walnut, while those of the left were normal and the tumor of the tongue had almost disappeared. The patient then felt so well that he returned to work and received no injections for twenty-five days; when I next saw him the disorder had started up again. This was owing, no doubt, to the premature interruption of the treatment, as the preceding patient, who received the serum more regularly, derived greater advantage from it, although the disorder was much more advanced.

In each case of this category the effect of the treatment showed itself soon after the second injection, the tongue and ganglia decreasing in size, pain disappearing almost entirely, and the patients beginning to swallow liquids, to sleep, and to speak distinctly. The longer the treatment was followed the better were the results. The weight of some patients remained the same, while that of others increased. In a few instances improvement was so noticeable that the patients considered themselves cured.

Ulcerated Malignant Tumors of the Cheek.—A patient of this class in M. Reynier's ward had the right cheek affected, with all the cervical ganglia of the corresponding side diseased, as well as the palate and gums. There were besides secondary tumors in the right lung and in the liver. The patient suffered a great deal, was very weak, had no appetite, and could not sleep. After receiving five in-

jections his general condition improved. Appetite and sleep returned, he felt stronger and began to take an interest in his affairs; but, in spite of this temporary improvement, he died two months after the beginning of the treatment, the disorder being too advanced and generalized.

The second patient of this category had a malignant ulcerated tumor of the left cheek, that had relapsed very quickly after operation, with all the ganglia of that side diseased; he had also an enormous liver and a syphilitic dilatation of the aorta. For two weeks sleep had been impossible. He was examined before treatment by Professors Berger and Dieulafoy. After the first injection pain disappeared, and the patient slept like a child, to use his own expression. Four injections were made in all, but, in spite of certain improvement, consisting in relief from pain, the man died a month after beginning the treatment, through generalization of the disorder in a syphilitic subject.

Two other patients of this class have just begun the treatment. One of them, in M. Berger's ward, has an enormous ulcerated tumor of the right cheek that has developed in two months. This patient could not breathe by the right nostril, nor open his mouth nor right eye, nor chew; there was also pain in the right ear. After the first injections the pain disappeared, and the patient began to open his eye and mouth and to chew better. Appetite and sleep have improved and the tumor has decreased in size.

Malignant Tumors of the Pelvis.—I have treated three cases of this sort. One of them, with cancer of the uterus, had been operated on a year previously, but the disease had recurred and her case was now hopeless. M. Richelot asked me to treat her by injections, to put her in such a condition that she could at least undergo scarification; after two injections this became possible, and a few days later she left for the country. The microscope showed epithelioma.

The second patient, who was suffering from malignant disease of the ovaries and peritoneum, with ascites, had already been operated on several months previously, and during the operation the peritoneum was found to be covered with disseminated tumors. Two months later nine litres of liquid had been drawn off from the abdominal cavity. The patient was then examined by M. Richelot, who found that all the abdomen, the uterus, and the ovary were diseased. On palpation, there were found in the right iliac fossa

a tumor the size of a goose-egg, and another one, smaller, with still others in the vicinity. The liver and spleen were enlarged and the right kidney was displaced and sensitive. The legs were swollen and the glands of the groin were enlarged. There was pain in the abdomen and lumbar region. The patient was pale, weak, could not walk, had no appetite, and did not sleep. Seven injections were made in this case; after the second one pain had disappeared, the ganglia had resumed their normal size, appetite had improved, and sleep had returned. The patient became stronger and gayer, so that she began to walk around and even went to make visits in town. After the last injection eleven litres of liquid were drawn off, and the tumors were found to have decreased in size and to have become painless to palpation. Two months after the beginning of the treatment the patient said that she felt perfectly well and was troubled only by the ascites. She then left for the country, where aspiration again became necessary. She is still under treatment.

The third patient of this series had generalized tumors of the ovaries, with enlargement of the intestine and stomach. Four injections relieved her suffering, but she succumbed to cancerous peritonitis.

Sarcoma of the Leg.—A patient of sixteen years was operated on by M. Reynier for an ulcerated, malignant sarcoma of the right leg. Two weeks later the tumor relapsed, and I then began treatment with the anticellular serum. After two injections the limits of the tumor became better defined, the ganglia in the groin and axilla, which were very large, had decreased in size, and her leg was then removed by M. Reynier. For two months after this second operation she was treated by the anticellular serum and gained fifteen pounds in weight. There were no signs of recurrence and the glands were not enlarged. Unfortunately, the patient was then siezed with grippe and died.

Operative Technique.—After many experiments I have finally settled on the following operative method: I inject beneath the skin of the thigh from seven to twelve cubic centimetres of serum taken from geese that have been rendered immune during a period of from eight to twelve months; the injection is renewed in from five to eight days, and after each injection the patient should remain in bed for twenty-four hours.

The success of the treatment depends on the length of time

during which the geese have been made immune and on the frequency with which the serum is removed from a given animal. The patient's general condition is also very important, as well as the presence or absence of hemorrhage, and the nature of the tumor, whether ulcerated, generalized, or localized. Loss of blood has great influence on the patient's strength and on the progress of the disorder.

This serum, therefore, seems to me to be the best remedy that we now have for malignant tumors; but the points still to be settled are how long the treatment must be continued, how long the progress of the disorder can be checked, and whether *complete* recovery from malignant disease can be effected by means of these injections. This anticellular serum differs from all other anticancerous serums in its origin, as it is derived from birds which are rendered immune by means of parasites obtained in pure cultures from human malignant growths. Animals inoculated with these blastomycetes show tumors with a rapid evolution and even of an epithelial type.

San-Felice has produced cancer in dogs, and I have produced adenoma in rats and monkeys and adeniform tumors of the liver in guinea-pigs. Treatment by the anticellular serum cured animals inoculated with the pathogenic blastomycetes, whereas the test animals inoculated with the same amount of the same culture and not treated with the serum of immune animals or treated by the serum of animals that had not been rendered immune, died from the tumors and cachexia.

Such are the results that I have obtained after two years' work on this subject. I intend to continue my researches in this direction, and hope to obtain a serum more efficacious still by rendering mammals immune by several months' treatment.

I think that the substance of the foregoing details can be summed up as follows:

1. The anticellular serum is harmless.

2. Reaction takes place where the injection is made, as is shown by the swelling.

3. Reaction also takes place in the tumor itself, which first swells and then begins to decrease manifestly in size.

4. During the reaction patients feel darting pains in the tumor, which after a series of injections becomes encapsulated.

5. The ganglia which are not affected by the disease itself, but are simply enlarged, return to their normal size; those that are really diseased decrease in size.

6. In the first period of the disease, when the tumor has not yet invaded the ganglia nor the neighboring organs, is not ulcerated, and is still of small dimensions, hypodermic injections of anticellular serum check its evolution and cause it to decrease in size. Marked improvement occurs even when the disease is much more advanced, provided that the treatment is regularly followed and that the patient is put on a suitable diet and allowed to rest. I lay great stress on these three conditions: *regularity in the treatment, diet, and rest.*

7. When the tumor is ulcerated and the lymphatic ganglia and neighboring organs are diseased, the evolution of the morbid process can still be affected by regular treatment.

8. The serum also produces a general reaction of the system, with slight elevation of temperature.

9. It increases the patient's strength.

10. It lessens or does away with pain.

11. Restores appetite and sleep.

12. Decreases the volume of the liver and spleen when they are enlarged.

13. Decreases or even puts a stop to fecal incontinence and loss of blood in cancer of the intestines.

14. The patients cease to lose and even increase in weight.

15. It hastens the process of blood coagulation.

16. After the injection the number of white globules doubles in the first twenty-four hours, while the number of red globules remains the same.

17. Finally, I must mention that among the twenty-six patients I have twice seen urticaria produced by the injection of serum.

THE MEDICAL PREVENTIVE TREATMENT OF RECURRENT HEPATIC COLICS.

CLINICAL LECTURE DELIVERED AT COCHIN HOSPITAL.

BY A. CHAUFFARD, M.D.,
Physician to the Paris Hospitals.

Cholelithiasis, though not often seen in hospitals, is very common among patients of the well-to-do classes. Hepatic colics are of every-day occurrence, and give rise to therapeutic indications and applications that are familiar to every one. Any physician, however, who sees many such cases must come to the rather unexpected conclusion that the majority of these patients are not looked after medically as they should be. Once the attack of pain is over and everything appears normal again, the physician too often thinks that his presence is needless, and gives to his patient no further attention beyond a few suggestions of general hygiene and diet, leaving the rest to be accomplished by a sojourn at Vichy or Carlsbad.

The question arises whether we cannot do something more efficacious to avoid the recurrence of these attacks, which are so painful and sometimes so dangerous. One would think not, to judge by the conduct of physicians generally and even by the most authoritative conclusions recently formulated concerning this important question.

Only last year two reports were presented to the Thirteenth International Medical Congress on the treatment of biliary lithiasis, and in the summary of these reports, which is all that has been published so far, this is what I find: "As regards biliary lithiasis, says Dr. Naunyn, the surgeon is the only person that can hope to effect complete recovery. As to internal therapeutics, nothing can be accomplished thereby except the relief of obstruction in the biliary ducts and the attenuation of infectious complications; once the disorder has become latent, the purpose of this form of treatment is attained."

In the same way, according to Gilbert and Fournier, "the study of the effect of the various cholagogue and lithontriptic remedies shows that we cannot effect the cure of biliary lithiasis by their means. Still, it is manifest that the expulsion of many calculi, and evident improvement if not actual recovery, can be obtained by regular courses at certain mineral resorts."

These conclusions are certainly not any encouragement, and amount in reality to confessions of impotence. My purpose in this article is to show that they must not be accepted without protest, and that it is our duty to do more than this for the relief and cure of this class of patients.

But what are we to understand in this connection by the word cure? Here we are met by a series of problems which our present methods of clinical investigation hardly ever enable us to solve. In a case of hepatic colic there are many questions concerning which a definite answer is usually unobtainable. We cannot, for instance, ascertain either the number, the size, or the age of the calculi, any more than we can the anatomical conditions or the degree of the lesions in the gall-bladder. Our clinical diagnosis is limited to the fact of the presence of calculi, with or without jaundice and with or without septic fever; and, once the acute attack is ended and apparent recovery obtained, we do not know whether the calculus has passed into the intestine, since the task of finding a calculus is always laborious and uncertain, and even when it reaches the bowel its ejection with the fæces may not occur until after a very varying delay.

It is, therefore, true that nothing but an operation can give the certainty of complete recovery for the time being; I say for the time being, and not definite, since I have already seen several recurrences of calculi in patients of this sort who had been operated on. A surgeon can remove the calculi that have already been formed, but he has no action on the disorder that gives rise to the calculi, any more than the crushing of a stone in the bladder will prevent ulterior nephritic colics.

For these reasons I think that the too absolute term of recovery should be set aside, and that it is preferable to state the question in this way: when a patient asks our advice for hepatic colics recurring at varying intervals, is it in our power—of course setting aside the mineral-water treatment, whose efficacy is not doubted—

to put a stop to these hepatic colics, or, at any rate, to lessen very considerably their number and intensity? This is the therapeutic problem to be solved.

The therapeutic indications to be filled for this purpose concern, on the one hand, the gall-bladder itself, and, on the other, its contents; we have, therefore, to lessen the reflex excitability of the bladder, to modify its anatomical state, and to check or prevent the evolution of the calculous cholecystitis. On the other hand, we must increase the rapidity of the flow of the bile by rendering it more abundant and fluid, we must obtain or ensure a clinical aseptic condition of the bile, and finally, and this would be the ideal in the question, we must act on the calculi already formed, so as to prevent their growth or lessen their volume.

As biliary lithiasis is an essentially chronic disorder, its treatment must be prolonged, without being unbroken, as we know that every long-continued treatment must be interrupted from time to time, and consist of alternations of periods of rest and action. This is, then, the physiologic and therapeutic plan of action; we must now consider the agents to be employed and the way in which they should be used.

After many experiments it has seemed to me that the remedies best suited to fill the indications just mentioned are salicylate and benzoate of sodium and Haarlem oil.

In the first rank I place salicylate of sodium, the use of which I recommended so long ago as in 1891 in the treatment of cholelithiasis. Many experimental researches have shown that this remedy is a very active secretory cholagogue, and that it makes the bile more abundant and fluid, either by increasing its liquid portion alone or by also increasing the amount of solid matter eliminated. To this increase in the biliary secretion, which is admitted by all physiologists, can be added an evident antiseptic effect, and a power to lessen pain, of which other therapeutic applications furnish the proof. These various properties explain the peculiar curative adaptation of salicylate of sodium to cholelithiasis.

But the dose to be employed should be very moderate, from one to two grammes per diem, and then only when the kidneys are in good order. In this way, even when the drug is given for a long time, we can avoid not only any toxic effect but any digestive or aciditive troubles as well.

Benzoate of sodium has been recommended as a cholagogue less liable to produce congestion of the liver than the salicylate. It seems to me clinically to be less active, but I combine it with the salicylate, both to avoid giving large doses of the latter and to cumulate the homologous effect of the two remedies. According to the gravity of the case and the tolerance of the patient, one can, therefore, prescribe from one to two grammes of salicylate a day, with an equal amount of benzoate of sodium, in from two to four wafers, at meal-time. It has also often appeared to me to be useful to add to this one or two grammes of Carlsbad salts. This treatment must be continued from ten to twenty days each month, according to the gravity and number of the attacks and the duration of the remission between them obtained; and this should be kept on for months and even for a year. It is only by persevering in this way that the cessation of the attacks will be effected and maintained.

Another remedy, borrowed from the old pharmacopœia, renders also the greatest service; this is Haarlem oil, a complex, balsamic, and resinous preparation, of which juniper oil appears to be one of the principal constituents. Every eight or ten days I give one or two capsules of this at bedtime.

This treatment, therefore, is based on the association of synergical remedies, and I have adopted it only after much experience. Modern tendencies disfavor complex therapeutics, and I think rightly so; we endeavor to find simpler methods, and to substitute in the place of the polypharmacy of former days the administration of agents well defined in their physiologic effects. But this should not prevent us from combining several remedies of a similar nature if clinical observation shows that such combination is useful, as I think it does in this instance. The administration of benzoate of sodium enables us to lessen the daily dose of salicylate, which is an important matter in a treatment that has to be kept up for a long time; and the Haarlem oil, which is also so efficacious in renal calculi, is a most useful adjuvant in the cure of cholelithiasis. This cure should naturally be completed by diet, stimulation of the skin, alkaline baths, exercise, and, whenever possible, a course at a suitable mineral-water resort.

Let us now see whether the efficacy of this systematic treatment continued for a sufficient length of time is borne out by clini-

cal experience. Here I may say that the cases which have come under my notice have been so numerous and conclusive that my mind is thoroughly made up. I will give the details of two of them, of which one is peculiarly demonstrative.

On January 10, 1899, a man about forty-five years of age was sent to one of the Paris surgeons and myself for the purpose of undergoing an operation. The patient himself, worn out by a long series of hepatic colics, was so reduced in strength and courage that he insisted on being treated surgically. His case was a serious one, since in a period of three years he had had seventy-four attacks, and that in spite of two seasons at Vichy. The notes of his case, kept with the greatest care by himself, showed thirty-three attacks in 1896, eighteen in 1897, twenty-two in 1898, and one on January 5, 1899. The attacks were typical of the disorder, lasted six or seven hours when they were short and without jaundice, but much longer, as much as a week on one occasion, when accompanied by jaundice. In 1898 several of these attacks were complicated by rigors and fever (104° F. on November 20). Since the latter date the patient had suffered almost constantly, the attacks following one after another without intermission. In consequence of all this he was very weak, and had fallen in weight from seventy-four kilos in 1895 to fifty-four kilos.

This was the lamentable condition of this patient when examined by the surgeon and myself. The region of the gall-bladder was very tender, but we found neither enlargement of the liver nor of the gall-bladder, no fever, and no jaundice. It appeared to us probable that the biliary lithiasis was complicated by a certain degree of cholecystitis and pericholecystitis, although this point could not be demonstrated clinically.

We had to consider whether a surgical operation was the last and only resource at our disposal. We ascertained from the patient that his history had been similar to that of most others of his category, and that his medical treatment had been a most elementary one: with the exception of two seasons at Vichy, a few bottles of Vichy-water from time to time, some baldo, and a certain amount of dieting, he had been treated without conviction and without method. I, therefore, asked the surgeon, who readily acquiesced, although this was not altogether to the liking of the patient, who had made up his mind to be operated on, that a medical treatment

should be instituted and continued for a month, barring unforeseen accidents.

The treatment was as follows: milk diet in small doses at first, as the patient was in constant fear of starting up an attack by eating, and helped out by nutrient enemata; later on, a greater amount of milk, and light feculent soups; after two weeks of this, a gradual return to a mixed diet of milk, vegetables, and a little meat. He took one and a half grammes of salicylate of sodium, with an equal amount of benzoate, in three doses each day; two capsules of Haarlem oil per week; alkaline baths, and dry frictions. During the entire year 1899 this treatment was followed, at first for twenty days in each month, and later for ten days only.

The treatment was completely successful: from the day on which it was begun he has not had a single attack for nearly two years; the most that he has had is that on two or three occasions he has felt his liver, without the inconvenience going any farther that that. His weight has gradually risen from fifty-four to seventy kilos, and all the occupations of a very active life have been resumed. His improvement was so rapid that on February 1, 1899, twenty days after the treatment was begun, the patient, who had not been operated on and was well satisfied with his condition, left Paris and underwent the fatigue of a ten hours' railway journey without bad results.

It seems to me that a case like this is a most striking proof; it is the most complete and convincing that I have seen, among many others of the same kind. The cases all resemble one another in the result obtained, the attacks being often abolished and always at least very much diminished in number and intensity.

Let me now make a few remarks about another case, which the patient's age makes particularly interesting.

On November 18, 1898, I was shown a man of eighty, who since April, 1897, had had a succession of typical attacks of hepatic colic, occurring every ten or fifteen days and accompanied by vomiting, sometimes with a little jaundice and always with bilious urine. He was an old sufferer in this line, as he had had a series of attacks between 1853 and 1855, with then a period of recovery of almost forty years.

When I saw this patient, he was extremely weak and had fallen in weight from ninety-eight to seventy-one kilos. In spite of his

age, his kidneys were in good condition, and, as there were no symptoms of biliary infection, I recommended the combined administration of salicylate and benzoate of sodium and of Haarlem oil, first for twenty, then for fifteen, and finally for ten days of each month. In this case also the accidents disappeared at once, and during two years the patient has had only two threatened attacks. I saw him recently, and found that he had regained his strength, while his weight had risen from seventy-one to seventy-eight kilos.

These are, therefore, manifest clinical proofs that we have in our possession a most efficacious treatment for cholelithiasis, or at any rate for its most painful manifestations; but success can be obtained only by a methodical treatment suited to the gravity of the attack and to the patient's constitution, and prolonged with intermittences for months and even for years. This treatment of biliary lithiasis may be compared to the methodical iodide cure of angina pectoris; we have there the same acute attacks and the same treatment by alternate periods of remedies and rest. I do not know, and even very much doubt, whether these calculi patients are cured in an anatomical sense,—that is to say, delivered from their calculi and with their biliary tracts restored to their pristine integrity. But we must not ask too much, and in seeking for perfection neglect these relative recoveries. To be able to transform one of these patients who is suffering into a patient who is free from pain, and who may possibly be quite cured, is a somewhat different affair from the practically negative conclusions that I cited in the beginning.

For my part, I am by experience so convinced of the efficacy of this medical treatment that I feel authorized to draw some practical conclusions applicable to the operative indications in cases of cholelithiasis. Setting aside, of course, the infected and bilioseptic forms and the cases of chronic jaundice, a patient with this disorder should not be operated on without having been first subjected to a vigorous medical treatment; if the latter gives no results, its failure is an indirect proof that, owing to anatomical conditions which, as a rule, laparotomy alone will enable us to determine, an operation is the only resource left to be tried.

But operations ought to be the exception, and my real opinion is that there ought to be no surgical treatment of cholelithiasis.

These patients come to the surgeon's hands only because we physicians do not treat them as we ought to do. If we were persuaded of the efficacy and the necessity of a medical treatment, and if we convinced the patient at his first attack of hepatic colics of the importance to him of this medical treatment, I am convinced that we would modify the evolution and prognosis of this complaint, which is so common, so painful, and so often beset with complications and dangers. We shall not always succeed, and the latent forms of cholelithiasis are too common for the medical treatment to have the time to act; but we can try, at any rate, and if we do so with method and perseverance, it will be for the welfare of our patients, as I have found in a great many instances.

THE CONSERVATIVE TREATMENT OF APPENDICITIS.

CLINICAL LECTURE DELIVERED AT TROUSSEAU HOSPITAL.

BY A. BROCA, M.D.,
Surgeon to the Paris Hospitals.

Gentlemen,—Many of you, no doubt, know that the *medical* treatment of appendicitis has recently been once more quite roughly handled before one of our medical societies. Now, in spite of the fact that we are all growing somewhat tired of this discussion, which is constantly cropping up afresh, I return to it again, because I think that some rectification is needed as regards the opinions attributed to the partisans of the medical treatment.

To begin with, it should be clearly understood that nothing but the *acute* attacks, with fever, and more or less severe, are in question; as regards *chronic* appendicitis we are all of one opinion,—that the only proper treatment is the removal of the appendix. But the mooted point is whether in an *acute* attack more patients are saved by operating at once, or by endeavoring by the judicious use of ice and opium to get through the period of inflammation so as to be able later on to operate at one's ease and with safety.

It will not be necessary for me to refer to the advantages of an operation performed when some time has elapsed since the acute attack occurred, over an operation done during the acute phase, as regards a definitely curative result and the avoidance of hernia. But I think it will be well to review some statistics that have been badly interpreted.

I shall not speak of statistics compiled from the results published by different operators. They are defective in that, as a general thing, each separate attack is counted, instead of each patient singly, so that a given patient may appear several times in the column of recoveries, but only once (and then for good and all!) in the column of deaths. I do not, therefore, attach undue importance to the large table of statistics in which Galliard credits the medical treatment of

appendicitis with ninety-three per cent. of recoveries. But I cannot pass over without comment the following lines, taken from the reports of the Bordeaux Medical Society.

"In opposition to these compiled statistics can be placed the integral statistics of two surgeons, MM. Brun and Broca, which show a mortality of from twenty-eight to thirty-three per cent. It is, of course, understood that these two surgeons had largely serious cases to treat, and cases in children, with whom appendicitis is probably somewhat more serious than with grown people; but, since the deaths of their patients are certainly not due to their operations, they must be attributed to the medical treatment which these surgeons use systematically in the early stages of the attack until its failure is manifest."

In view of the fact that Brun and I are, as a rule, in favor of medical treatment during the acute phase, the above deduction appears to be closely logical; but there is, nevertheless, a flaw in it that I shall try to point out. I do not know what Brun would reply, but I know the value of this argument as far as it concerns myself.

I have on many occasions stated, and recently again in a publication on this question, that my experience must be divided into two periods, with a transition phase between them, of course.

From 1892 to 1895, at Trousseau Hospital, I almost always operated on children as soon as they were admitted or, at any rate, a few hours later, the orders being that I was to be sent for in each circumstance. Beginning with January, 1896, influenced by Jalaguier, I moderated my zeal. Before that time the only cases that I abandoned to the medical treatment by ice and opium were the very harmless ones, mere appendicular colics, with no appreciable swelling and with hardly any rise of temperature. Little by little I tried this method with cases of increasing gravity, until I became the much-despised opportunist that I am to-day.

Now, the unfortunate point in the Bordeaux Society argument is that the thirty-three per cent. death-rate referred to is the one published in the thesis of one of my pupils that appeared in July, 1896; in other words, these figures apply precisely to the period during which I was on the radical side!

But I shall go farther than this, and sift out the seventy-nine cases on which this thesis was based.

I find seven light cases, not operated on, all recoveries; eight

cases operated on long after the acute stage was over, all recoveries; sixty-four cases operated on during the crisis, with thirty-eight recoveries and twenty-six deaths.

As to the cases that recovered there is nothing to say, and this is equally so about the time at which the operation was done. But as regards the deaths it is well that I should mention the moment at which the operations were performed, which can be verified in the thesis in question.

Of the twenty-six cases twenty-three were operated on immediately,—as soon as the child was received in my wards. I have now only to give the details of the three deaths that occurred when the operation had been postponed.

A mere glance will show that in one case the delay was not responsible in any way.

A boy twenty-six months old, taken ill March 8, 1895, entered the hospital March 9, was operated on March 11, and left the ward cured on May 5. But the appendix, which I had not seen during the operation, kept up a series of little abscesses, with an intermittent fistula; and, as I was not very eager to undertake a laborious operation in so young a child, I postponed from day to day, at each slight recurrence, the removal of the appendix and cleansing of the focus, until at length, on August 28, acute peritonitis set in, to which the patient succumbed on September 3. At the post-mortem I found the small intestine perforated where it had been compressed by a band of the omentum. This case taught me never to postpone a radical operation when fistula occurs after simple incision of the abscess, and in this I am right, as all my other cases of this sort have recovered. But, so far from proving that the delay in operating was the cause of death, this case shows that the postponement of twenty-four hours did not prevent the child from recovering from the acute crisis.

In the following case, on the contrary, I take the blame for the delay, which I think was fatal, and which is explained not by an unfortunate attempt at medical treatment, but by mistaken diagnosis.

On September 19, 1895, was brought to my wards a boy of eight, who on the preceding day had returned from school in great pain from a kick which he had received in the right side of the abdomen from one of his playmates. He ate no dinner, vomited three times

during the night, and passed, so I was told, several black stools. I found the child, the next morning, no longer vomiting, and with pulse and temperature normal. The abdomen was hard and painful, but neither palpation nor percussion enabled me to find any localized focus. I considered the possibility of appendicitis for a moment, but, on account of the unmistakable fact of the kick, concluded that it was a case of abdominal contusion, probably without intestinal rupture, and ordered ice and opium. It is not for me to say whether my mistake was justifiable or not; but mistake it was, sure enough. On the morning of the 22d the child was in fair condition, although his face was more drawn; but I questioned whether I was on the right track, as there was some resistance and dulness in the iliac fossa. I did not, however, have a chance to rectify my diagnosis, for at 3 P.M. bilious vomiting set in, with severe abdominal pain and hyperpyrexia; one of my colleagues, who was at once sent for, made an incision on the middle line and drained the abscess in the right iliac fossa, which did not prevent the child from succumbing the next day from general suppurative peritonitis, as was shown by the post-mortem. We then found that the appendix, which was largely perforated, had given rise, as initial lesion, to a big pelvic abscess, that had, of course, not been drained; this explains why I did not get the right diagnosis during the first stage of the attack, the right iliac fossa having been empty at that time.

This is, therefore, a case in which the fatal delay was my fault. As for the other deaths, simple consideration of the dates will show that they were not due to me. I think that several of them might have been avoided if the children had been cared for in time (which does not mean that they should all have been operated on at once); but I wish to lay stress on the fact that I operated as soon as the cases were received in my surgical wards, and I cannot be held responsible for the days that preceded. One would not think so after reading the *résumé* of these cases given by Imbert in a recent article, in which he calls attention to the harm done by the method of delaying the operation; and in these *résumés* I should, as well, like to see the fact mentioned that nearly all of these patients had been purged at a most unfortunate moment, and often purged a second time.

On the other hand, although before the Bordeaux Society my surgical skill was not doubted, and it was said that the death of my

patients could not be laid to the operation itself, I think that this was not always the case, and that it is likely that in some instances I inoculated the peritoneum by breaking adhesions at a period when the peri-appendicular pus was still extremely virulent. Thus, in the case of a girl of eight and a half, ill for a week, who entered the hospital on October 2 and whom I operated on October 4, 1895, I attacked a pelvic focus containing a little pus and fungous matter by passing through the peritoneum in a healthy state, after which I removed the appendix, the child dying on October 8. In this case I think there is no doubt that the final peritonitis was due to my operation, as the septic focus had not had time enough to settle down. This in the incriminated series is the third and last case of an operation delayed by me of my own free will, and, as regards the last one, the only accusation I have to make against myself is that I did not delay it longer.

Let us analyze some more of these fatal cases. We can eliminate that of a girl of eleven, who died, a month after the operation, from intestinal obstruction due to an epiploic band, the initial focus having been operated on as soon as the child entered the hospital; secondary laparotomy, which unfortunately failed, being performed, owing to my absence, by my friend Jalaguier. To an operation badly done can be laid the death of a boy of eight, who, although his abdominal cavity had no longer any trouble in it, died, five days after the operation, from a septic inflammation of the abdominal wall, due to an unfortunate suture of this wall around a drainage-tube, which taught me to give up suturing after opening abscesses. I furthermore regard as unavoidably fatal, at the time when I was called on to see the patients, eight cases in which death by diffuse peritonitis occurred on the day of operation.

But when death occurs two or three days or more later, is not the general peritonitis that is found post mortem sometimes the result of the operation itself? As regards my earlier operations I am in this respect less indulgent towards myself than the Bordeaux Society, since in certain autopsies the signs of peritonitis seemed to me to be very recent, and especially because my death-rate has decreased in enormous proportions since I have learned to wait.

Among my case-notes of the first years there are some lacunæ. I have, therefore, had notes taken from the hospital books of all cases of appendicitis admitted to the wards that I directed from

1892 to the present time. It is from January, 1896, on that the favorable influence of my friend Jalaguier began to affect my course of action, as it was at that time that he became my neighbor in Trousseau Hospital. The figures are as follows.

From 1892, when I went to Trousseau, to 1895, sixty-seven cases gave in my hands forty-five recoveries and twenty-two deaths, —in round figures a death-rate of thirty-three per cent.

In 1896 I had thirty cases, with four deaths, which make up the twenty-six deaths mentioned in the thesis above referred to. Please observe that, since my complete statistics at the date of that thesis ought to have contained ninety-seven cases (less a few that occurred at the end of the year), the difference between that number and the seventy-nine mentioned in the thesis concerned cases only that recovered, and not deaths. I had taken notes on all the serious cases, but had neglected some that recovered without operation and some mild cases. My total figure, therefore, ought to have been twenty-six deaths in ninety-seven cases,—about twenty-six per cent. But my figure for 1896 was 13.33 per cent.

In 1897 I had twenty-eight cases, with three deaths,—10.70 per cent.; in 1898, sixteen cases, with three deaths,—18.79 per cent.; in 1899, thirty-seven cases, with four deaths,—10.81 per cent.; and, if I add eleven cases in private practice, with one death, the figures for 1899 become forty-eight cases, with five deaths,—10.43 per cent. I have not included my cases in private practice before 1899, because before the present discussion arose I was not in the habit of keeping the memoranda necessary for compiling these statistics.

The year 1898 does not show up as well as the others; but, although among my papers for that year I only find fifteen case-reports, instead of the nineteen reported by the hospital, it so happens that my memoranda include the three deaths, and thus we are in a position to see whether these deaths are to be attributed to my delay in operating. I mean, once more, delay on *my* part, as, let me say it over again, the greater number of deaths occur because for a certain length of time the children are badly taken care of at the beginning of the attack.

On May 24 a girl of four and a half was brought to me. She had been ill for twenty-seven days. I could get no exact information about the evolution of the complaint, but I saw that pus in abun-

dance was flowing from the umbilicus and I was told that it had begun to do so that very morning. The next day I found, under chloroform, that a probe penetrated towards the iliac fossa, and I made Roux's incision, finding an enormous abscess going from the umbilicus to the bottom of the pelvic cavity; I saw and removed the appendix. The temperature fell to 36.8° C. and remained there for three days, but the child died from exhaustion on the evening of the 28th, in spite of injections of serum, and with no symptoms of peritonitis.

A child of six and a half fell ill on July 20, and began to vomit on the 21st after a purge had been given her. On the 22d a boric enema was given every three hours, and on the 23d at 1 P.M. she was brought to the hospital, where her temperature was found to be 38.5° C. and her pulse 160 and thready. The entire abdomen was tympanitic and painful, and the right iliac fossa was dull to percussion. The same day at 4 P.M. I opened the abscess and drained it, but the child died the next day, with diffuse peritonitis, observed at post-mortem.

No one, I think, will blame me for these two deaths, and every one will agree that up to the time of their admission to hospital these children were treated (whether or not with the advice of a physician) in a fashion that defies common sense. In the case of the third death, an imperfect diagnosis, due to the difficulties that I shall give in a moment, must be incriminated, as it led to a partial operation only.

A boy of fourteen years and a half was seized on December 3 with distress and loss of appetite. On the following day pain in the lower portion of the abdomen with colics and slight diarrhœa set in. On December 5 the child took to bed, complaining then of almost constant pain, and remained in this condition, with pain and constipation but without vomiting, until the 9th, when he vomited some black stuff twice and was brought to the hospital.

I then found that the abdomen, which was painful everywhere, was so tympanitic that complete palpation was impossible; still, I was able to ascertain that there was neither swelling nor special resistance, neither increased pain nor difference in sonorousness in the right iliac fossa. If these signs existed anywhere to a slight degree, it was above the left crural ligament. Rectal examination gave me no information, the tympanites making bimanual palpa-

tion very unsatisfactory. I made the diagnosis of appendicitis, but without being able to ascertain whether there was an abscess, and, if there was one, from which direction to approach it. I found nothing to the right, and very little to the left; and in acute crises of appendicitis, when you find no tumor or adhesions, exploratory laparotomy on the middle line gives most unfortunate results, from having to attack the abscess through the peritoneal cavity without adhesions. The pulse was about 100, full, regular, and strong, and the temperature 37.8° C. In spite of this, on account of the pain and tympanites, I concluded that an abscess was in process of formation, and held myself ready to act as soon as I could perceive some indication to show me from which direction to get at it.

This occurred on the following day. The temperature had fallen to 37.2° C., the pulse was still at 108, but good. During the night there had been porraceous vomiting, and, although the right iliac fossa was still empty, there was unquestionably somewhat near the middle line some dulness on percussion. I, therefore, made an incision on the left side along the outer edge of the rectus muscle, and a great quantity of fetid pus issued from the incision; I inserted two large drainage-tubes, which entered some distance downward and backward.

After the operation, with the exception of a slight rise (to 38.2° C.) on the evening of December 12, the temperature remained between 37.2° and 37.6°; but, although the pulse was good, I was never quite easy in my mind. There was no more tympanites, the pain had disappeared, and palpation, which was once more practicable, revealed nothing to me, even when combined with rectal exploration; but the child was uneasy, with ashy hue, and each morning I looked carefully to see whether any localized sign would put me on the track of another collection of pus. My suspicions were well founded, as I ultimately discovered, but all my examinations bore no fruit. Finally, on December 19, evident symptoms of violent peritonitis set in during the day: agitation, broken respiration, hollow eyes, pinched nose, wretched and irregular pulse were followed by death at ten o'clock in the evening. At the post-mortem the pouch that I had drained was found to be practically empty, but in the upper part of the pelvic excavation there was a second one, in which the appendix, completely detached, was floating, together with a large stercoral calculus. From this pouch had

started an outbreak of suppurative peritonitis, with multiple foci, of which there was one large one beneath the liver and several small ones between the agglutinated portions of the small intestine.

With this patient it is true that I waited twenty-four hours before opening the first abscess. Those surgeons who know what difficulties are connected with this form of appendicitis, with deep initial focus and multiple secondary foci, will not be too severe with me for doing so; but they may perhaps tell me that when, two or three days later, I found an unusual degree of restlessness, such as is met with when a focus remains necessitating a second incision, I should have been wiser in making an exploratory median incision; and it will be easy for them to point out to me in addition that, however bad results the latter process may give, the patient could not have lost much in the end. It is possible to use this case as an argument against making a simple incision without looking for the appendix, by saying that, if on the first day I had with deliberation looked for the appendix to remove it, I should not have passed over the deep abscess in which it was swimming; but the case cannot be used against the partisans of delay in treating the acute phase of this disorder.

Consequently, in 1898 I had nineteen cases at Trousseau and lost three of them; but it is not possible to find among the number a single victim of the medical treatment applied in the proper manner from the moment the patients came into my jurisdiction. I pass over the cases of 1897, because I have not in my possession full enough data concerning them; though I find in my notes the history of a boy who, operated at the usual point as soon as he entered, on December 4 (the fourth day of the attack), had to undergo on the 9th another operation for an intraperitoneal abscess in the left side, and died on the 12th, with two other foci, one beneath the umbilicus and the other at the insertion of the omentum.

I also remember, in the same year, a case operated on far away from any acute phase. The focus, which was still infective, had to be drained, and afterwards suppurated. This boy died from intestinal obstruction some time later.

As regards the third death for that year I have neither notes nor recollection of it. My opponents can claim it if they wish, but to no profit, as six deaths in fifty cases is not so very bad a result.

I then come to 1899, during which I had thirty-seven cases in

the hospital and eleven in private practice. In the preceding years I have not mentioned my private patients, as I am without precise data; but I am certain that I did not lose a single one, whether operated on or not, and this could only have improved my figures.

In 1899, then, I had four deaths in thirty-seven cases at the hospital and one death in eleven cases in private practice,—five deaths in forty-eight cases, or 10.43 per cent. Here are the details of these five deaths.

1. A boy who entered on May 9 was operated on at once and died during the day. No delay on my part can be claimed here.

2. A girl who entered on December 4 was operated on December 9 for an iliac abscess on the right side. About December 25, after having been in good health, she began to vomit, without showing any symptoms of peritonitis. On December 28 it was manifest that she had intestinal obstruction, and I made an incision in the middle line. The small intestine was bent completely double by adhesions at three points, one above the focus and beneath the liver, the other two on the right side of the pelvic cavity. While freeing these adhesions I opened the abscess that had been drained and found a calculus in it; acute peritonitis carried off the patient. There was no trace of peritonitis when the operation was performed, and the five days' delay at the beginning had nothing to do with the fatal ending.

3. In this case the death was due to a delay that depended in part on me. The patient was a boy who had been ill for two weeks and who had been purged over and over again. Dr. Comby, who was called in consultation, did not think there was appendicitis, in spite of the opinion of the family physician, who had finally come round to that diagnosis. When, in presence of serious symptoms of peritonitis, the child was at length brought to the hospital, I found myself in a serious predicament. There was nothing clear about the early part of the attack; on the other hand, the abdomen was uniformly distended, sonorous, and painful, and rectal exploration showed no swelling. The pulse was not too bad, although very rapid; so that I remained in suspense December 14 and 15; finally, on the 16th, as the child appeared to me to be going down hill very rapidly and as the muscular contraction appeared to be greater on the right side of the abdomen, I made an incision in the iliac fossa and found pus. The child died on the 18th, and there is no doubt

that I was wrong in waiting forty-eight hours. It is almost certain that there was already general peritonitis when the child entered the hospital, and that of fifteen days' delay two must be laid to my charge when the symptoms, in case the attack was one of appendicitis, called for an immediate though hopeless operation. I found, it is true, no focus, either by pressure, percussion, or palpation; but I ought to have been guided by the law that with males every attack of peritonitis (excepting the rare cases of pneumococcic peritonitis) is due to appendicitis and calls for laparotomy, which is also indicated in pneumococcic peritonitis.

4 and 5. These two cases have no connection with the present discussion. They concern patients operated on several weeks after the acute phase and where, instead of finding extinct foci, as I expected, I found pus and adhesions to such an extent that in one the cæcum, very brittle, was torn in several places. These cases are interesting as regards the proper length of time to wait after the acute phase before operating, the method of drainage, the choice between Roux's and Jalaguier's incision, and the diagnosis of residual abscesses; but in their connection I never had to raise the question of the best moment at which to operate in an acute attack of appendicitis.

Now, as regards the patients who recovered in that year,—this is how they can be grouped according to the time at which they were operated; it should always be borne in mind that I only speak of the period during which they were under my immediate direction.

Fourteen cases were operated on during the acute phase,—one at once, three on the second day, three on the third day, five on the fourth day, one on the fifth day, and one on the seventeenth day

Twenty-eight operations were done far away from the acute phase, after a varying delay, concerning which it is not necessary to go into details. I wish to remark that I saw almost all of these patients during the acute period, that I got through this period with the help of the medical treatment only, although there was in several of them unmistakable swelling, and that, although in one instance I regretted having operated too soon, I never regretted having operated too late.

This complete account of the deaths that have occurred among my appendicitis patients shows clearly that since the appearance of the thesis mentioned above, in 1896, my death-rate has been ten

in ninety-two cases, or 10.86 per cent., instead of twenty-six per cent.; and it should be noted that in 1896, when I began to be opportunist in opinions, this death-rate was 13.33 per cent., whereas during my radical period it had been thirty-three per cent. I do not suppose that this confession on the part of a radical will make many surgeons change their opinions; but I hope I have shown in an irrefutable manner that it was a mistake to say, before the Bordeaux Medical Society, that the statistics taken from the thesis in question were those of an opportunist. If these gentlemen had been good enough to read the case-reports and look at the dates, and if they had remembered that on many occasions I have reproached myself in public for having been a radical, they no doubt would not have committed this error, which has done more harm than good to their cause.

In about two hundred cases I can be accused of having on four occasions delayed too long and of having permitted an attack of peritonitis to continue which I might have been able to stop; but in all four cases the patients were such that the delay was due to uncertain diagnoses and not to the symptomatic study of a well-diagnosed attack of appendicitis. Let him who never made an error in diagnosis throw the first stone at me.

The fact that does cause me sorrow is that formerly I failed in cases where I now succeed. The patients are still of the same class, and the proof is that, in the hospital to which I am surgeon, the operation always performed at once gave in 1898 in twenty-eight cases fifty per cent. of death in the wards next to mine. When I changed my plan, I went from 33.3 per cent. to 10.43. The difference is too great to be due to the chance of a lucky series.

My opponents will reply that they do not understand how I do this, and that, for their part, they never lose any patients other than those in whom peritonitis has begun before the operation, and whom they operate on as a last chance because once in a while a patient of this sort is saved from death. I wonder whether this is really the case; and I wonder because I remember what I used formerly to think. It is very difficult to decide whether peritonitis that is fatal preceded or followed the operation, and the instinctive tendency of all of us leads us to think it existed before we operated. Thus, when I operated on all cases at once, I conscientiously believed that my failures were due to pre-existing peritonitis which continued in

spite of my operation. But now that I wait I lose only one-third as many patients, and it is impossible for me not to believe that I treat them more skilfully. Either, when peritonitis exists that can be cured, it is better treated in the medical way than by going at the focus; or, and this is my opinion, the peritoneum is only irritated about the focus, and in operating adhesions are broken down without the fact being perceived.

This is why I have based my opinion on my entire statistics, and not on two series: localized foci, all cured; diffuse peritonitis, all dead. A possible objection can be made to this method, and I may be told that my total is better because, thanks to the efforts made by the radicals, the patients, whether in hospital or in private practice, reach the hands of the surgeons quicker, at the beginning of the crisis. On examining carefully the dates of the case-reports, it is seen that this argument is inexact, but it will not be necessary for me at the present time to go into this detail. To show that a number of cases taken as a whole do not change, I have only to take the statistics given last year by Kirmisson before the Surgical Society.

On January 1, 1898, Kirmisson took over the wards in Trousseau Hospital that I had formerly had in charge as Lannelongue's *locum tenens,* and on February 1, 1899, he gave his total figures for acute appendicitis. This report concerns twenty-five cases with thirteen deaths, while the hospital report gives twenty-eight cases with fourteen deaths. I should not mention the latter if it did not somewhat improve the situation. The total gives a death-rate of fifty per cent., which is even worse than my figures between 1892 and 1895, when I was a radical. I am not sorry to note this, while I am on the question, as from reading what has been published in this connection one would think that the figures given in the thesis of 1896 contained an extraordinarily high death-rate.

During the same year, 1898, in the same hospital but in different wards, I had sixteen cases with 18.75 per cent. of deaths; while in 1897, in the wards occupied the next year by Kirmisson, I had had twenty-eight cases (the same number as he had) with 10.70 per cent. of deaths; and in 1899, thirty-seven with 10.81 per cent. of deaths. I have given these figures a second time, as comparing them with those of other wards in the same hospital shows that the cases that now come to the hospital are no milder than those of former years.

It is, therefore, the fault either of the surgeon or of the method; now, I have gone into all these details to show that when a surgeon changes his method the results improve; it is, therefore, the fault of the method and not of the surgeon.

Nor can my opponents claim that in my total there is a large number of operations done at a distance from the acute phase and known to be less dangerous, as almost all of these operations were done on patients whom I had brought through the acute phase and whom I operated much later on, owing to the great diminution in risk.

There are still, I know, many obscure points on this question, such as the clinical differences caused by the infection of the appendix and peritoneum by different varieties of microbes; but in a series of two hundred cases the different varieties are probably represented in their proper proportions and in sufficient numbers for two series of such numbers to be comparable in their entirety. This comparison has clearly convinced me that I did well to change my method. I have no great hopes of making many proselytes at a time when a certain amount of discredit is connected with the slightest appearance of surgical timidity; I shall be content with having corrected an error, and to have shown, to those who are of my way of thinking, some figures that appear to me conclusive.

THE ADULTERATION OF FOODS.

BY EMIL SCHLICHTING,

Assistant Chemist to the Dairy and Food Commission, Department of Agriculture, Pennsylvania.

When the necessity of food in the maintenance of life is considered, the importance of accurate knowledge of its chemical composition, manufacture, and particularly its adulteration and sophistication becomes at once apparent to every one, especially to the physician.

The tendency among manufacturers and dealers to produce and sell food-stuffs which are either below standard or different from what they are represented to be has developed remarkably within the last decade. It is not so much the fraud practised upon the consumer as the menace to public health by sophistication of food that should receive the stricter attention of the medical profession. There should be an intense interest in obtaining and enforcing laws to prevent the evils which necessarily result from such adulterations.

Investigations zealously made by many scientists have shown that the adulteration of our food has reached such tremendous proportions that nearly every country in the world has been compelled to pass and enforce laws protecting its people against these fraudulent practices. Pennsylvania has had dairy and food laws ever since 1895. The regulations have constantly been made more strict, and now extend to almost every manufactured article of food on the market. To illustrate the importance of pure food, it will be sufficient to describe some of the results of the investigations and the character of food adulterants.

Milk.—As milk contains in the proper proportions all the necessary elements for the nutrition of man, it is one of the most perfect foods. It consists of water, proteids (casein and albumin), carbohydrates (milk sugar), fat, and mineral matter. As it constitutes the main article of diet for infants and invalids, laws regulating its sale cannot be too rigidly enforced. It is well known, however, that no food is more exposed to adulteration than milk. Water,

which, of course, considerably decreases its nutritive value, is the chief adulterant. In the last few years the addition of preservatives and coloring matters has become quite common. The coloring matters consist mostly of aniline orange and caramel, while the preservatives used are borax, boric acid, salicylic acid, sodium carbonate, and formaldehyde or formalin. Of all these the most dangerous probably is formalin, which, combining chemically with the proteids of the milk, rendering them insoluble and indigestible in the stomach, may prove injurious to health, even when used in small proportions. Weak solutions of formaldehyde, such as freezine, are used extensively by the milk dealers, who are led by the manufacturers to believe that these preservatives cannot be detected in milk. In pamphlets on their products the manufacturers say: "*It is not an adulterant. It immediately evaporates, so that, as soon as it has rendered all the bacteria inert, no trace of it can be found. No chemical analysis can prove its presence in the milk.*" Some deliberately recommend it as beneficial to the health of infants! The laws of Pennsylvania do not allow the use of preservatives or any other foreign substance in milk.

Condensed Milk.—This valuable article of food is largely used in consequence of its less perishable character. Its principal faults are a deficiency of milk fat and sometimes the presence of preservatives.

Butter and Oleomargarine.—Butter is adulterated by adding preservatives; by increasing the amount of salt and water; by the insufficient removal of milk, so that the butter soon becomes rancid; and, most frequently, by the addition and substitution of foreign fats (animal and vegetable). Products of this type are variously known as oleomargarine, butterine, margarine, etc. In its nutritive value oleomargarine very much resembles milk-butter, and from a hygienic stand-point nothing can be said against its manufacture and sale, provided that fats from healthy animals and pure vegetable oils are used. Its manufacture should, however, be conducted under strict supervision, a proper sanitary condition of the factories should be insisted upon, and this artificial substitute for butter should be branded and sold as such. It would then offer to the poorer class, at a moderate cost, a food rich in fat, a substance so necessary to complete nutrition.

Renovated Butter.—This product, also called boiled or process

butter, has for several years found a ready sale. It is a much less desirable food than oleomargarine, being manufactured from old, stale, rancid, unsalable butter, by remelting and churning the latter with skimmed milk. As the temperature at which the fats separate from the stale curd is much below that at which sterilization is generally effected, renovated butter quickly decomposes and becomes rancid; it is, therefore, very unwholesome.

The dairy and food laws of Pennsylvania prescribe that each package, tub, or parcel containing either of these substitutes for creamery butter shall be plainly marked in a conspicuous place with the words "Oleomargarine," "Butterine," or "Renovated butter," as the case may be.

Flour, Bread, etc.—The adulteration of flour consists mainly in the substitution, entirely or partially, of one flour or starch by another of a cheaper grade. In wheat flour, for example, were found ground peas, rice flour, and corn meal. Rarely alum is added to increase the whiteness. Sometimes copper and zinc sulphates are used to improve the appearance of bad flour. Impurities of parasitic origin, which cause mouldiness and decomposition in flour and in bread or other preparations made therefrom, should be considered dangerous. The so-called diabetic or gluten flours have always been largely a fraud, deceiving physicians as well as the public. Owing to the difficulty of their manufacture, they generally contain from ten to eighty per cent. of starch, although many of them are represented by dealers to be practically free from starch and to consist only of gluten. As they form the principal food of diabetic patients, the investigation and strict control of the manufacture of these products should be encouraged. A law standardizing their composition would be most beneficial.

Some of the coloring matters used in certain pastries and cakes may prove injurious to health, but little has lately been reported as to the deleterious effects of any such substances. The color agents which are objectionable on account of their highly poisonous character are chrome-yellow, martius-yellow, picric acid, dinitro-cresol, dinitro-naphtol, etc. At present, however, the coloring matters used are mostly harmless, consisting either of the yolk of egg, colors of vegetable origin, or harmless coal-tar dyes.

Baking-Powders.—These consist of bicarbonate of sodium with some acidifying agent, usually bitartrate of potassium, acid phos-

phate of calcium, or alum. Tartaric acid is occasionally used. These substances are mixed with some material called "filling," which is usually starch or flour. This filling checks deterioration in the strength of the powder by preventing the acid and alkali from readily acting upon each other. Ammonium carbonate is sometimes used to increase the strength of the powder. The impurities most commonly met with are calcium sulphate, calcium tartrate, and insoluble calcium phosphate. They are introduced with the ingredients of the powder. But under the ordinary circumstances in which baking-powders are used they are harmless. It would be difficult to define adulteration of baking-powders, since no standard of this class of preparations exists, other than that which has been arbitrarily proposed in accordance with the claims of rival manufacturers. The great differences of opinion in regard to the use of alum as an ingredient in baking-powder offer an important question in the field of investigation. Whether or not alum, present as aluminum hydrate, in the bread after baking, is injurious remains a physiological problem, the solution of which will be a distinct advance in the cause of pure food legislation.

Lard and Olive Oil.—Besides cotton-seed oil, which is its chief and commonest adulterant, lard frequently contains other vegetable oils and quantities of stearin and oleostearin from beef and sheep fats. Sometimes as much as twenty per cent. of water is used; this may be worked into the lard without changing its appearance to any extent if at the same time a moderate quantity of an alkali be added. In 1899 the Pennsylvania Legislature passed a law to prevent fraud in the sale of lard, and the penalties provided are inflicted when these impure products are placed upon the market, unless the packages are plainly marked "Compound lard." Seventy-five per cent. of the olive oil in our markets consists of mixtures of cotton-seed and other oils, such as peanut oil, palm oil, etc. It is well known that most of our "pure imported Lucca oil" comes from the cotton fields of Georgia. From there it is sent in bulk to Europe, where it is used to adulterate olive oil, and is then returned to us, labelled "Pure olive oil." Sometimes oils colored green with copper salts have been found in the stores.

Molasses, Sugar, Honey, and Confectionery.—The bulk of molasses and syrups at present on the market is more or less largely adulterated with commercial glucose. They are also often found

to contain tin salts, which are added for the purpose of bleaching, but which are naturally objectionable on account of their poisonous properties. Sulphites and hyposulphites, used for the same purpose, are occasionally detected in some light-colored New Orleans molasses. Commercial glucose is extensively mixed with syrups; fruit syrups are often found to contain coloring matter and, as a preservative, salicylic acid. The usual adulterant of maple sugar is some form of cane sugar, with which it is almost identical in composition. Honey, especially strained honey, is frequently adulterated with cane sugar, but oftener with commercial glucose, which may constitute seventy-five per cent. of the sweet fluid supposed to be supplied by bees. In some cases the honey has been separated from the comb, which, after being placed in vessels, has been covered with glucose and then sold as pure comb honey.

The term "confectionery" embraces such a variety of substances that it is scarcely practicable to define a standard of purity. The sugars (most prominent of all the constituents), starch, chocolate, fruits, nuts, flavoring materials, and coloring matter are all used in its manufacture. The cheaper grades of candy generally contain commercial glucose (instead of cane sugar), starches, and a gum, such as gum tragacanth. As a rule, however, these ingredients are not harmful. The greatest evil is the use of coloring matter which is poisonous, but that usually employed consists of an organic dye which has no injurious properties.

Canned Goods.—The practice of preserving various foods in hermetically sealed receptacles has become so common that the manufacture and sale of such products should be under the control of stringent laws, to prevent the dangers which are apt to follow their unlimited use. Though these preparations possess obvious advantages, they, especially the canned meats, have also a serious drawback: poisonous ptomaines or other toxic products of putrefaction may develop in them either before the can is opened or afterwards. The metal of the cans, as well as the solder used in sealing them, may prove another source of danger, for the inner plated surface often corrodes and the metal is dissolved by the acid contents. Harmful salts of tin and lead are thus produced.

Canned vegetables, jellies, jams, etc., are very frequently artificially colored, and may contain imperfect or refuse material; also, and this is not the least important, various preservatives are found

in them. Catsups generally contain large amounts of salicylic acid and coloring matter, which are used in order to hide the presence of refuse material.

Jellies and jams are frequently nothing but glucose and starch paste colored and flavored with essential oils, without the slightest trace of fruit. Such preserves, according to the present laws of Pennsylvania, should all be marked "Compound," but, in my opinion, even this does not lessen the deception and fraud practised, and will never prevent the sale of products which present the most flagrant and extensive adulteration.

The bright green color observed in some canned vegetables usually results from the use of copper utensils. Under ordinary circumstances, when care is exercised in the preparation of green vegetables, they contain only a slight amount of copper. The German food laws do not allow more than ten milligrammes of copper per kilogramme in peas, etc., and any sample containing more than this proportion is condemned. The Pennsylvania laws require such goods to be labelled "Artificially colored." The French at one time permitted the canned goods put up for export to be colored green by copper sulphate, but did not allow those offered for home consumption to be so colored!

The use of salicylic acid as a preservative in any canned foods is in Pennsylvania positively prohibited by law, for reasons quite evident to the physician. Other preservatives, such as the sulphites, should also be excluded by law, since they are likewise considered detrimental to health.

Tea, Coffee, Cocoa, and Chocolate.—Adulteration of these articles is not infrequent. The sophistication of tea, however, has considerably decreased in the last few years, through the rigid enforcement of the United States tea adulteration law. Stems, fragmentary leaves, and various kinds of dirt are often found in tea, but the deliberate substitution of foreign or exhausted leaves is comparatively rare.

The chief addition to coffee, which is usually adulterated only when sold in the ground form, is chicory. There have been on the market artificial coffee-beans made from roasted cereals, molasses, various roots, etc.; but the ease with which they are detected has, in America at least, caused these spurious products to disappear from the shops. On the other hand, cocoa and chocolate offer favorable

opportunities for profitable adulteration. Sometimes the natural fat (cocoa butter) is extracted and replaced by other fats, but in most cases the debasement consists in adding as much as fifty per cent. of cheap flour. Sometimes ground cocoa husks are liberally mixed with the crushed kernels in order to offer the consumer a cheaper article, on which, however, the manufacturer reaps a large profit. Coloring matters, such as Bismarck brown and oxide of iron, are added to low grades of chocolate.

Wine and Beer.—These beverages are subject to extensive adulterations, and, although no standards for their chemical composition have been adopted, the use of the many substitutes which now enter into their manufacture should be prohibited by law. The addition of glycerin, glucose, licorice, salicylic acid, arsenic, soda, and many flavoring agents to beer is common, while the sophistication of wines by alcohol, sugar, coloring matter, and many other substances is an every-day trick of the trade. The frequent investigation of these beverages and a strict control of their production, especially important because of the enormous amount of them daily consumed, cannot be too forcibly recommended by the medical profession. The recent cases of poisoning at Liverpool and vicinity by arsenic which had been added to beer as a preservative and the production in many instances of arsenical neuritis will be at once recalled.

Vinegar.—Vinegar is most commonly adulterated by the addition of water, pyroligneous acid, mineral acids, and caramel and other coloring matters. The new law of Pennsylvania provides that cider vinegar must be the product of pure apple-juice, without standardizing the amount of solids and the acidity. Pure cider vinegar usually contains from 3.5 to 6 per cent. of acetic acid and 1.5 to 2.5 per cent. of solids. Distilled and malt vinegars, if sold as such and not artificially colored, are not prohibited. Since cider vinegar is no longer standardized, vinegars offer opportunity for fraud and suffer considerable sophistication, chiefly by dilution with water.

Spices.—Perhaps in no other class of dietary articles has scientific adulteration been carried to such an extent as in spices. Fraud and deception in this line have been practised with exquisite skill. Not only the color and taste but even the structural appearances of certain spices have been so closely imitated in manufacturing "mixed goods" (as the spice man calls them) that their identifica-

tion requires most careful scrutiny by the trained eye of an expert in microscopical analysis. For nearly every kind of spice certain substitutes are in use, but to enumerate them all would require much space. Among the most common adulterants used are sawdust, charcoal, sand, wheat middlings, roasted peas, mustard hulls, linseed meal, cracker dust, oil-cake, olive-stones, nutshells, and mineral matter. Moreover, a good many spices, as ginger, mustard, mace, etc., ere they reach the consumer have been deprived of their most valuable constituents. Since the Pennsylvania law does not permit the addition of any foreign matter to spices, the adulterated articles cannot legally be sold as "compound," but there have been found in the market many samples containing fifty per cent. of alien substances, labelled "strictly pure" and "guaranteed to comply with all the pure food laws of this State."

The present enforcement of our pure food laws is as good as can be expected under the circumstances; but the alarming increase of fraud practised upon the public and the dangers to health arising from deliberate adulteration show the growing necessity of *national pure food laws* regulating the manufacture and sale uniformly throughout our own country and protecting the honest manufacturer in his relations with foreign competitors. A bill for the prevention of adulteration, misbranding, and imitation of foods, beverages, candies, drugs, and condiments, has been introduced into Congress by Mr. Brosius. Should this bill become a law, the present unfortunate conditions would no longer be possible in our markets. Its justification is amply proved by the preceding statements, and in order to insure its early passage a systematic effort should be made by the medical profession to induce congressmen to vote for the "National Pure Food Bill." It will be acknowledged that the physician is most competent to judge of the injurious effects of food adulteration and sophistication.

Medicine

SMALLPOX, WITH PARTICULAR REFERENCE TO THE PREVALENT EPIDEMIC.

BY JAY F. SCHAMBERG, M.D.,

Professor of Diseases of the Skin at the Philadelphia Polyclinic and College for Graduates in Medicine.

A WRITER has said that, if a Londoner of the eighteenth century could walk the streets of the great English metropolis to-day, the most striking change to him would be the comparative absence of pock-marked faces. Through the beneficent influence of the Jennerian discovery, the ravages of the once-dreaded scourge smallpox have been so lessened as to have robbed it of much of its terror. Nevertheless, the antivaccination agitation which is heard upon many sides and the apathy concerning vaccination which is born of long freedom from the disease may arouse the dormant monster. Within the last quarter of a century there has been in the United States no widespread or virulent epidemic of variola, and the comparative freedom from this disease has lulled the lay and even the medical public into a sense of complete security. This feeling is just now, in many places in this country, receiving a rude shock. After the termination of the Hispano-American war there was discovered, first in the Southern States and later elsewhere, a disease which, on account of its aberrant symptomatology, gave rise among physicians to considerable diversity of opinion and at times even to heated argument. The disease was variously regarded as chicken-pox, smallpox, impetigo contagiosa, Cuban itch (a name without an entity), and as a hitherto undescribed dermatosis. Many physicians who had seen more or less of the old type of smallpox could not possibly believe this new affection, with its variant symptomatology, to be the same malady. They had never seen or heard of a variola which would from the onset of the eruption permit so many of its

victims to pursue their daily labors. Others, however, noting the similarity or identity of the more severe cases with the history and course of true smallpox, insisted upon the variolous nature of the affection.

The failure on the part of many to recognize the true character of the disease has led to its wide diffusion, so that to-day few States can boast entire freedom from smallpox. While the epidemic is widely disseminated throughout the country, it has not reached alarming proportions except for brief periods in a few localities.

From the beginning of this year until April, twelve thousand three hundred and forty-four cases have been reported by the Marine Hospital Service, as against seven thousand four hundred and ten last year, an increase of nearly five thousand cases, or 66.5 per cent. On the other hand, only one hundred and eighty deaths are reported this year, against three and ninety-one last year, a decrease of 72.4 per cent. in the rate of mortality. At least part of the increased number of reported cases this year may, I think, be attributed to a more universal recognition of the disease, particularly the milder cases, which were earlier regarded as chicken-pox. The higher mortality-rate last year was doubtless also in large measure more apparent than real, owing to the exclusion of so many of the mild cases. That the disease is still to be dreaded is shown by the statistics in the city of New York. Between December 1, 1899, and March 23, 1901, out of a total of four hundred and seventy cases there were seventy deaths, a mortality-rate of nearly fifteen per cent.

The symptomatology of the prevalent mild form of smallpox is in the main that of varioloid, or smallpox modified by vaccination. But the epidemic has largely seized upon unvaccinated individuals, and, *mirabile dictu,* it has nevertheless maintained a degree of mildness unique in the history of the disease. The mildness of any epidemic disease must, in the light of modern bacteriological knowledge, be regarded as due either to an attenuation in the virulence of the exciting cause (presumably an animal or a vegetable micro-organism), to a lessened susceptibility (heightened resistance) of the individuals affected, or to a combination of both of these factors. In the present epidemic of smallpox, however, it is a matter of the greatest difficulty to set forth a theory which will satisfactorily explain all of the facts.

The disease is ushered in, as a rule, by a rigor, which may in

Fig. 2.—Mild discrete smallpox on seventh day of eruption. Type of varioloid. Note practical absence of lesions on trunk.

mild cases amount to nothing more than chilly cutaneous sensations. This is followed by a rise of temperature, which may vary from 101° to 104° or 105° F. Headache is present in most cases and is at times violent. Lumbar pains are severe in some patients, while in others they may be entirely lacking. A general aching in the limbs is often complained of. Nausea and even distressing vomiting may occur. Vertigo, which becomes manifest upon the patient's assuming the erect position, though not present in all cases, is frequently observed. When the temperature is high there may be delirium, and in children stupor and convulsions.

These prodromal symptoms are present to a greater or less extent in nearly all cases, and constitute a syndrome of important diagnostic value. In some patients they are severe, in others so mild as scarcely to cause information to be volunteered concerning them when but casual inquiry is made, but upon close and specific interrogation the patient will usually remember that two or three days before the eruption appeared he had one or more of the symptoms referred to.

The character of the prodromal symptoms is of considerable prognostic value in forecasting the extent of the eruption. High fever with severe prostration usually indicates a profuse eruption, though severe prodromes are occasionally followed by a comparatively mild smallpox. Mild prodromal symptoms are nearly always followed by a sparse eruption.

Upon the outbreak of the eruption the temperature falls often to normal, and the patient feels generally better. In mild cases he may feel quite well and may desire to pursue his usual occupation. The writer has seen a number of patients in the early stages of the eruption apply for treatment at the out-door service of a dermatological clinic. Many of the patients stated that they had had the "grippe," and that the doctor had given them medicine which had produced the "breaking out." A patient was also seen during the height of the eruption driving a carriage along one of the chief thoroughfares of the city.

The eruption first appears as minute papules, which manifest themselves primarily upon the face, arms, and hands. In from twenty-four to forty-eight hours the full complement of lesions has, as a rule, appeared. The papules are acuminate, firm, and "shotty" to the finger passed over them. Vesiculation and pustulation are

prone to develop more rapidly than in the old-time variola, so that vesicles may be observed on the second or third day and pustules often on the fourth or fifth day. Crusting soon follows, and, as the dried exudate falls off, there is a striking and rapid transformation in the appearance of the face. The features, instead of being swollen and distorted beyond recognition, suddenly acquire their normal contour and proportions. Many cases even of moderate severity recover with little or no pitting. In a certain proportion of cases vesicles develop upon the apices of papules, and, on the shedding of the crusts, there remain tuberculated, flat-topped, solid elevations, which at times present a warty appearance (*variolois verrucosa* of older writers). One unfamiliar with this condition might believe the patient to be in the papular stage of the eruption.

As a result of the very superficial involvement of the skin, there is not only a lessened tendency to pitting but also a milder degree of secondary fever This phenomenon, being due to septic absorption from the integument, is, as a rule, proportionate to the extent and depth of cutaneous involvement. In many cases the suppurative fever is insignificant or even entirely absent.

While most of the cases of variola observed in Philadelphia during the last few years have belonged to the type above described, the disease has lately shown a tendency to revert to its original form, as illustrated by the following case, that has recently come under observation.

Mr. X., aged twenty-four, viewed a patient with smallpox of mild type for about three minutes at ordinary conversational distance. X. had been vaccinated from time to time in infancy and youth, but had never had a successful "take." Vaccination was advised after the exposure referred to, but was neglected. Twelve days later X. was suddenly taken ill, with chills, headache, vertigo, pains in the limbs and back, and a rise of temperature to 104° and later 105° F. Three days afterwards there appeared, first upon the face and later elsewhere, an extensive papular eruption. From this time on the disease pursued the usual course of the old-time variola. The eruption was enormous in extent, the lesions aggregating probably from five thousand to ten thousand. Secondary fever began upon the sixth day, and, whilst it did not rise above 103° F., it made the ultimate result for the time being doubtful. The patient, however, made a good recovery, complicated only by

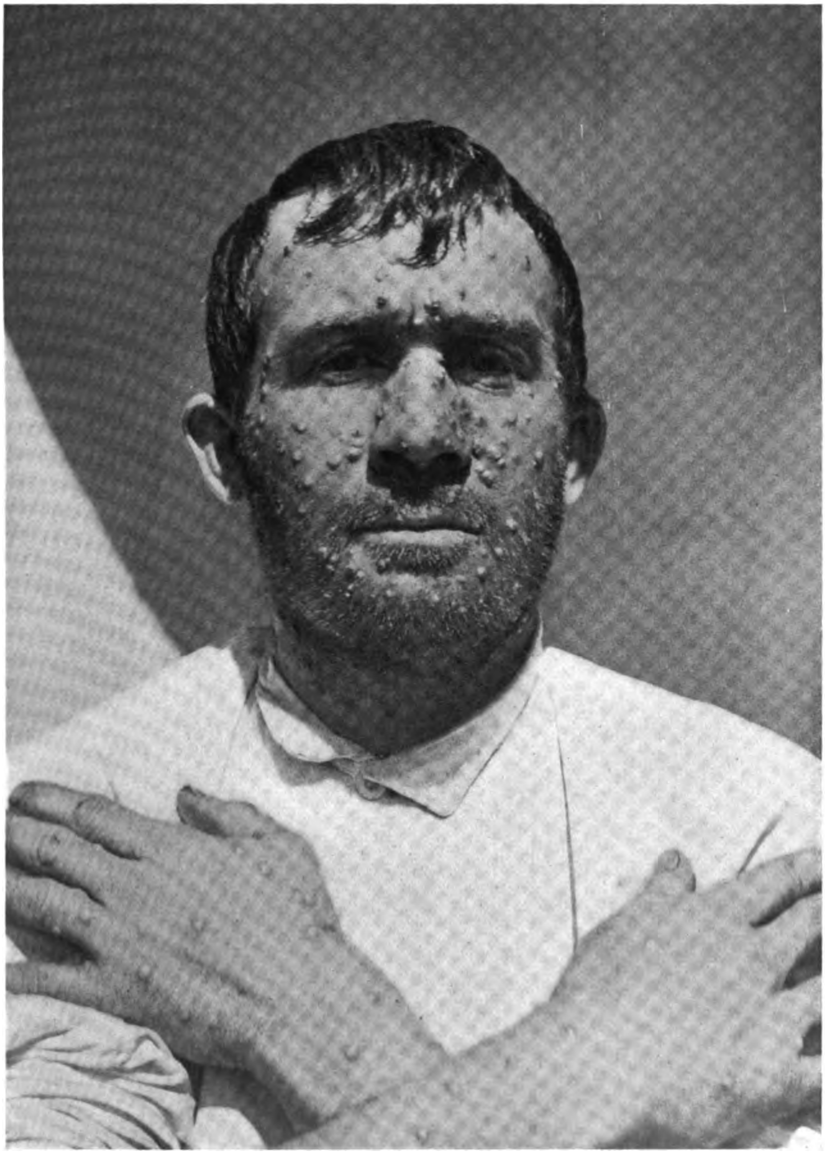


FIG. 3.—Mild discrete smallpox on sixth day of eruption.

Fig. 4.—More severe type of variola. Compare semiconfluent lesions on face with discrete eruption upon trunk. Seventh day.

the development of boils. At the present time he shows great pigmentation and numerous pits.

More recently several patients have died from the disease,—the first deaths from smallpox that have been authentically reported in Philadelphia for five years. Cases of this character sound a note of warning to those who would underestimate the danger of the present epidemic because of its mildness.[1] Dr. William M. Welch, of this city, than whom there exists no more eminent expert on smallpox, in a letter to the Pennsylvania State Board of Health, written two years ago, made the following prophetic remark: "It seems scarcely possible that a disease as fatal as smallpox ordinarily is can continue very long without assuming its characteristic severity."

Differential Diagnosis.—Smallpox may be distinguished from chicken-pox, the disease with which it is most apt to be confounded, by attention to the following data.

1. Prodromal symptoms: Fever, headache, backache, chills, vertigo, nausea, etc., occur two or three days before the outbreak of the variolous eruption. In exceptionally mild cases, however, these may be slight or even absent. In chicken-pox the fever and the eruption appear practically synchronously.

2. Constitutional symptoms: More severe in smallpox.

3. Distribution of eruption: In smallpox eruption involves with predilection face, arms, hands, and legs; upon the trunk the lesions are more sparse. In chicken-pox the eruption is most profuse, as a rule, upon the trunk, chiefly the back. Smallpox prefers the exposed surfaces, chicken-pox the covered.

4. Character of the lesions: In smallpox they begin as firm, "shotty" papules, which slowly increase in size and develop into vesicles and pustules. Vesicles are uniform in size and often show umbilication. They are multilocular and difficult to rupture with the finger-nail. Chicken-pox lesions begin as "dew-drop-like" vesicles which have a velvety feel. They are unilocular, thin-roofed, can be easily ruptured with the finger-nail, and vary greatly in size.

5. Manner of eruption: Chicken-pox eruption comes out in

[1] It is scarcely necessary to reiterate the oft-confirmed statement that the most virulent attack of small-pox may be contracted from a patient suffering from the disease in its mildest possible form.

successive crops, and the lesions may be seen in varying stages of development. Smallpox eruption comes out in a single crop and the lesions remain uniform in character.

6. Course of eruption: Smallpox lesions undergo a gradual evolution from papules to crusts in the course of eight to ten days. Chicken-pox lesions last one or two days and then crust. In the recent mild smallpox the lesions maturate more rapidly than in the old-time smallpox, but the course of the eruption is nevertheless much longer than in varicella. The severity of the eruption is no absolute guide in the differential diagnosis. Severe cases of varicella may look far more formidable than mild cases of variola. The writer has seen undoubted smallpox in unvaccinated individuals, with but two or three lesions present, and the general symptoms correspondingly mild.

The pustular syphiloderm, particularly that variety known as the variolaform syphilide, may at times present a striking resemblance to smallpox, and may require careful study to be differentiated therefrom. During epidemics of smallpox such cases are frequently regarded as variola. These pustular eruptions are usually not the first cutaneous manifestations of the disease, but often follow upon the macular or papular syphilides. They may occur about the fifth or sixth month or later between the first and second year of the disease. They are more common in negroes than in whites, and in the debilitated and under-nourished than in robust individuals.

History: In syphilis one may obtain information concerning the initial lesion and perhaps an antecedent eruption; also the presence or former existence of mucous patches, alopecia, tonsillar ulceration, iritis, remains of chancre, etc. In smallpox there is a history of exposure to the contagion of variola.

Prodromal symptoms: This complex of symptoms is well marked in smallpox two or three days before the appearance of the eruption. In the pustular syphiloderm there may be moderate fever preceding and accompanying the eruption, also general aches and pains. On the one hand there is no such remission of the febrile symptoms on the appearance of the cutaneous efflorescence as is seen in smallpox, and on the other hand the constitutional disturbance during the prodromal period and later during the eruptive stage is much less severe and prostrating. Patients with a pustular syphilide are not apt to seek their beds.

FIG. 5.—Variola. Stage of desiccation. Twelfth day of eruption.

FIG. 6.—Papular elevations left after shedding of the crusts. Fourteenth day. (So-called variola verrucosa.)

Eruption: The syphilitic eruption comes out in successive crops; it may or may not be more extensive upon the trunk than upon the face. The papules are often firm, but are apt to acquire vesicopustular summits rather than become vesicular or pustular in their entirety. They never progress to those large, full, deep-seated pustules which are so characteristic of variola. The vesicopustules dry into small, brownish crusts, which when cast off disclose to view infiltrated, elevated papules or at times exulcerated bases. Often a little epidermal colarette is seen, showing beginning desquamation of the base of the lesion. The lesions are not invariably uniform in size, and often papules and pustules are interspersed. Occasionally there is a tendency to grouping, which is best noted about the alæ of the nose, commissures of the mouth, border of the hair, etc. The eruption of syphilis, as a rule, pursues a distinctly slower course than that of smallpox. The itching which is sometimes present in variola is usually absent in syphilis.

Despite these differentiating symptoms, there occur at times cases which defy even the experienced eye to make an immediate diagnosis. Observation of the patient for a few days will usually disclose the true nature of the disease.

A confounding of smallpox with *impetigo contagiosa* can come only from a misunderstanding of the nature of the latter disease, which is a purely local dermatosis resulting from inoculation of the skin with pyogenic micro-organisms. The eruption is usually limited to the face or the face and hands, and is particularly common in children. The lesions do not, as a rule, exceed a dozen in number, and general febrile symptoms are of great rarity. The lesions are primarily thin-roofed vesicles or blebs, which rapidly become turbid and dry into yellowish flat crusts. These are cast off in the course of a week, leaving a faint reddish stain. The vesicopustules are extremely superficial and flat, not at all infiltrated, and result usually from finger infection. The affection is contagious only through direct or intermediate contact. Many cases in adults result from inoculation in a barber-shop.

Extensive *papular and pustular drug eruptions* at times simulate smallpox, but may usually be differentiated by the absence of the characteristic constitutional and local symptoms of the latter disease.

CROUPOUS PNEUMONIA.

DIDACTIC LECTURE TO THE THIRD YEAR CLASS OF THE UNIVERSITY OF PENNSYLVANIA.

BY JAMES TYSON, M.D.,

Professor of Medicine in the University of Pennsylvania.

Gentlemen,—Croupous pneumonia is an acute inflammatory disease of the lungs, and is characterized by a high fever, which terminates by crisis in from five to nine days. The disease is commonly attributed to the *Diplococcus pneumoniæ,* or Fraenkel-Weichselbaum bacillus, a bacterium especially prone to occur in pairs or chains and found in more than seventy-five per cent. of all cases of lobar pneumonia. As early as 1880, before Fraenkel described this diplococcus and pointed out its important *rôle,* it was discovered by Surgeon-General Sternberg, of the United States Army, and a little later by Pasteur. But neither of these men recognized its causal relation to the disease. Nor was this microörganism the first to which was ascribed the production of pneumonia. Three years previous to the demonstration, in 1886, of the diplococcus in the excretions of hepatized lung, Friedländer isolated what he called the pneumococcus, and regarded it as the cause of pneumonia. The bacterium of Fraenkel is, however, the one commonly found. Both organisms are encapsulated, but that of Friedländer is a distinct bacillus, there being rarely two, while that of Fraenkel is found in pairs or even in bead-like rows. The diplococcus is formed by the junction of the broad ends of the lanceolate bodies. It stains well by Gram's method, which, on the other hand, promptly decolorizes the bacillus of Friedländer. In other respects these two distinct organisms are quite similar. Other cocci also may cause pneumonia. Thus, there is a malignant form due to the streptococcus, while a severe type may result from the presence of the meningococcus, the specific bacillus of epidemic cerebrospinal meningitis.

This disease is also designated adjectively according to its dis-

tribution. Lobar pneumonia, which is the term applied to this morbid process when the whole or most of one lobe is involved, is practically synonymous with croupous pneumonia and contrasts with lobular pneumonia or bronchopneumonia, in which only a few lobules, more or less, are involved. The term double pneumonia is used when both lungs are either slightly or extensively infiltrated. Usually the right lower lobe is affected, but in old people and children especially the apex may be the seat of the trouble, in which case the pneumonia is called apical. Creeping pneumonia is a variety in which the inflammation spreads from small to large areas, and may thus invade the whole lung. This, too, is a grave form.

Not until Laennec's time, in 1819, was pneumonia finally separated and clearly distinguished from pleurisy. Its infectious nature was announced in 1872 by Jürgensen, just about the time when the microbic origin of disease began to excite serious attention. The inference was reasonable, in view of the fact that a ship's crew, the inmates of a hospital ward, or a family were at times all stricken with the disease. Pneumonia is commonly a general infection, although I believe it may in some instances be primarily local, just as diphtheria is. The local form is usually mild, the general infection severe. Certain predisposing causes have much to do with the etiology. For instance, a tired medical man, who reaches home after a long cold drive, thoroughly chilled, may, in the evening, have a severe rigor ushering in an attack of pneumonia. Any fatigue or debility due to other diseases, as well as exposure, acts as a predisposing cause.

Morbid Anatomy.—There is no disease in which we have a more definite knowledge of the changes which constitute its anatomy than pneumonia. We speak of three stages,—that of congestion, of red hepatization, and of gray hepatization. During the stage of congestion the lung is simply hyperæmic, the air-vesicles are still capable of inflation, and the lung is not nearly so heavy as in the later stages. This lasts only about twenty-four hours, at the end of which time red hepatization begins. The lung now becomes three or four times its normal weight, so that it will no longer float in water, and so much enlarged that the imprint of the ribs may be found upon it. The cut surface is gritty, and by the touch are noted sand-like particles, which correspond to the little fibrin masses distending the air-

vesicles. If scraped away and examined under the microscope, these are found to consist of a mass of blood-disks, fibrin and granular fatty cells, which, formerly known as compound granule cells, represent fatty alveolar cells. These were first called inflammatory globules by Gluge. In the third stage, or that of gray hepatization, the alveoli contain the same fatty granular cells, with many leucocytes, but almost no red disks. The lung has acquired a gray color, due to these changes. After this, if the patient recovers, the greater part of the exudate is absorbed or expectorated. Probably absorption, and not expectoration, is the greatest factor in removing this soft substance from the convalescing lung. Associated with the morbid changes already described is nearly always found more or less pleurisy. When this is general, the disease is known as pleuro-pneumonia, the most striking symptom of which consists in the marked pain and tenderness, such as never occur in pure pneumonia.

Symptoms.—With the exception of pyæmia, no other infectious disease is so frequently ushered in by a chill, which in some degree is rarely absent. Though it sometimes occurs, there is not often a marked prodromal period. After the chill, the most striking symptom at the beginning of the disease is the fever, which reaches 103° or 104° F. and above. A patient now at the University Hospital was admitted with a temperature of 105° F., which fell to 104° F., and has remained at about that point up to the present time. The pain, contrasted with that of pleurisy, is dull. When it is sharp, an associated pleuritis can usually be ascribed as the cause. The breathing rate is accelerated, and increases in proportion to the degree of lung involvement. It may number thirty, forty, fifty or even eighty and more respirations per minute. There is a cough, which is always short and loose at first, but soon becomes dry; it may become loose again as convalescence sets in. Generally at the end of the first twenty-four hours after a chill the expectoration is tinged with red. This symptom is often absent or delayed. The sputum is gelatinous, and so tenacious that when the patient attempts to expel it the mucus adheres and he ejects it only by forcible effort. We are always glad, after the beginning of resolution, to see a return of the expectoration, the consistency of which depends upon the quantity and condition of the contained blood. It is often named "prune-juice" or "rusty" sputum, from its resemblance to prune-juice, although it may be bright red. At the beginning of an

attack of pneumonia the patient has a bright eye and keenly notices all that goes on around him. The temperature is rising a little, and he often suspects his condition.

This state of affairs may persist from five to seven days, at the end of which, in favorable cases, the crisis occurs. The temperature, the number of respirations, and the pulse-rate all fall at the same time, while coincidently the patient may drop into a refreshing sleep. This is a picture of a case that proceeds directly to a favorable termination, though not in every instance does a seeming crisis end the attack. There may be another rise of temperature before the real crisis comes. The first of these is called a pseudo-crisis, which in serious cases may recur a number of times without a final fall in temperature taking place before the patient's death.

Physical Signs.—The patient lies on the affected side. At the very beginning Skodaic resonance over the part affected may be noted upon percussion. This is called "Skodaic resonance by direct relaxation." The earliest stage during which this is present is, however, likely to pass unnoticed. Characteristic of the first period, when the lung is simply congested, are the crepitant râles, which are heard especially at the end of inspiration. They have long been compared to the sound produced by rubbing the hair between the fingers in the vicinity of the ear. They are a distinct and convincing sign of pneumonia. The friction sound of pleurisy often resembles them, and is, I believe, not seldom indistinguishable. The friction sound is, however, more superficial than the crepitant râle, and is not, like the latter, heard especially at the end of inspiration, but is rhythmical, corresponding to the to-and-fro friction of the pleural surfaces.

In the second stage the lung is swollen and presses against the ribs, so that there may be, though not constantly, an obliteration of the costal interspaces. The percussion note is absolutely flat. Tactile fremitus is increased. The ear detects typical bronchial breathing, which consists in a blowing inspiration with a prolonged, higher-pitched expiration, frequently tubular in quality. When the patient speaks, bronchophony is heard by the ear pressed against the chest. These are the physical signs of the consolidated lung. The resonance over the neighboring normal areas may be increased, in consequence of relaxation (Skodaic resonance by indirect relaxation); it may, indeed, be very marked. A cracked-pot sound may

be produced by percussing the solid lung, as a result of the sudden expulsion of air from a large bronchus leading to the solidified area.

The third stage, or that of gray hepatization, in which the consolidation still persists, presents a set of physical signs very similar to those of the second stage. We still find increased vocal resonance and fremitus, with on percussion impaired resonance amounting to dulness or flatness. Finally we hear, to a certain extent, the crepitant râle, which for a time had disappeared. It is now called the crepitans redux, and is an indication that the air is again entering the diseased tissue, causing a crackling of the soft exudate as it passes through. This is a distinct sign of resolution. As the process completes itself, the lung becomes more and more resonant. The quantity of air entering and leaving the lung constantly increases.

Every case does not follow this rule, especially when there is an associated pleurisy. The physical signs may be changed, owing to the displacement of the lung by an exudate, which, if liquid, may easily confuse us. It is not impossible to have pneumonia on one side and pleurisy with effusion on the other. I have seemingly such a case now at the Philadelphia Hospital.

The symptoms of pneumonia as detailed are subject to modifications. In the first place, the chill may be very slight or rarely absent. The temperature, while usually high, is not always so. In old people it may not exceed 100° or 101° F., and the same is true of alcoholic subjects. The pulse may be anything but strong. Especially are the symptoms liable to modification in children and old persons, in whom the apices are likely to be affected. The breathing rate varies considerably. It is frequently very high, numbering as many as eighty respirations a minute. The characteristic dull pain of which I have spoken is often wanting. Cough and expectoration are also subject to variations.

The chlorides are absent from the urine during the height of the disease, but reappear with the crisis. It is not known what becomes of them, but it is said that they pass out with the fibrinous exudate.

The characteristic feature of the blood is a leucocytosis, which ranges from ten to twenty thousand per cubic millimetre. I have now in the University Hospital a patient with a leucocytosis of nineteen thousand. The blood is also highly charged with fibrin, and,

in most cases, when drawn shows a decided buffy coat, which was well seen in a patient whom I bled to-day.

Jaundice is an occasional symptom and may usher in the attack. It is ascribed to a cholangitis, which in all likelihood is caused by the pneumococcus. Probably in grave cases it is due to blood disintegration and a consequent staining of the skin (hæmatogenous jaundice).

Herpes appears in from twelve to forty per cent. of all cases. The only other diseases markedly characterized by this eruption are intermittent and cerebrospinal fevers. It is, you will remember, conspicuously absent in typhoid fever.

A complication presenting itself with sufficient frequency to warrant a reference to it, is phlegmasia alba dolens, although it occurs much more rarely in pneumonia than in typhoid fever. In a comparatively recent paper the late Dr. J. M. Da Costa reported this condition in nine cases, three of which were in his own practice. It is due to thrombosis and obstruction of a vein, usually the femoral.

The term " typhoid pneumonia" is sometimes used, but it should be reserved for those cases of true pneumonia in which the typhoid state is prominent. Then we find the typical dry tongue, the coma or low delirium, the nervous symptoms, and profound depression.

Streptococcus pneumonia, due to the ordinary pus organism, is much more serious than other forms. Its onset is slow and insidious, never sudden; for this reason, it has been suggested that the so-called influenza-pneumonia may be of this type.

As contrasted with the usual termination in resolution with crisis, about four per cent. of all cases of pneumonia end in abscess of the lung. After an extraordinary extravasation of colorless corpuscles, the abscess forms as in any other tissue, and commonly occupies part of a lobe, but may be so large as to include it entirely. Another unusual termination, also put down as occurring in about four per cent. of the cases, is gangrene of the lung. It follows a very exaggerated state of hyperæmia, in which the pulmonary vessels are so engorged that the circulation is arrested. Bronchiectatic cavities, with their putrefactive contents, form a predisposing cause. It is commonly announced by an excessively fetid expectoration, the odor of which may fill the whole ward. Even from a condition so grave as this the patient may recover. I have now such a case in the University Hospital, and we are not certain

whether a pneumonia or tuberculosis was originally present. Such a mortification of lung tissue is particularly apt to occur when a pneumonia supervenes upon a tubercular process. The physical signs of abscess and gangrene are not always what you would expect. Sometimes, indeed, those of a cavity are found. Another rare termination is fibroid induration. When resolution is delayed two or three weeks, as sometimes happens, tuberculosis must also be thought of, though usually cases ending in that disease have been tubercular from the outset.

The commonest complication is pleurisy, and of this I have already said something. It is associated in a greater or less degree with almost every pneumonia, but I now refer to those instances in which the lung or lungs are surrounded by a pleuritic inflammation. Endocarditis is a frequent complication. Fully twenty-five per cent. of all cases of malignant endocarditis have been found to be due to the pneumococcus. Of course, the heart's condition is announced by the usual signs when these are decided. Sometimes, however, they are not distinct, and then we must rely on the chills, sweats, and irregular temperature,—in other words, on the hectic symptoms, of which this disease is one of the causes. The non-malignant variety of endocarditis also rarely accompanies pneumonia. A routine examination of the heart may prevent any such inflammation from being overlooked. Cerebrospinal meningitis may be caused by the same infection.

Pneumonia does not always begin on the surface of the lung. The process may begin in the centre and work gradually to the periphery. Until this occurs the signs are wanting; in old persons three or four days may elapse before they appear. It is even said that there may be pneumonia without pain or physical signs.

The *diagnosis* is generally easy. It is in cases associated with pleurisy that the signs are obscure, especially when this complication is first seen in the third stage of the disease. As I have often told you, bronchial breathing is common in pleurisy with effusion, on account of the lung being compressed while the bronchi remain patulous. Usually resonance and fremitus are diminished. Sometimes, on the contrary, in the presence of thin layers of fluid, vocal resonance may be increased and even acquire the ægophonic character. Tactile fremitus is, however, always diminished where there is an effusion, and remains a help in the diagnosis. If there be an

alteration in the line of dulness upon change of the patient's position, this will help to settle the question. In the first stage of both diseases we must distinguish between the friction sound and the crepitant râle; but I have already spoken of this matter in sufficient detail. We have in the beginning about the same degree of impaired resonance, but in pleurisy there is extreme tenderness, often elicited by percussion, and the cough is much shorter as well as more painful.

The *prognosis* of pneumonia is, in my judgment, the most uncertain of all acute diseases,—that is to say, we are never quite sure how the case may turn out. A strong young fellow may die in two or three days, and an old person tottering to the grave may get well. Probably the fatality amounts to about twenty-five per cent., which is a larger death-ratio than earlier years showed. Some of the older men still say, it is because we have largely given up the custom of bleeding. It is due rather, I think, to changed conditions. Children sometimes recover when restoration to health is least expected. More people die of pneumonia in the cities than in the country. The causes of death, apart from the complications, are not always the same. I believe that in most instances the patient dies from cardiac failure, which results from the direct action of the pneumonia toxin upon the cardiac muscle. This poison may be sufficiently powerful to produce death in three days or even less. In other cases its effect is more tardily exhibited, and the patient may live eight or nine days and then succumb. Again, the heart may be paralyzed by distention of its right cavities, and death may ensue from asphyxia. Pulmonary embolism is also an occasional cause of a fatal termination. Usually at the necropsy the right heart is found to be engorged, while the left chambers are empty.

Treatment.—The treatment of pneumonia, like the prognosis, is exceedingly unsatisfactory. We do not yet know of any single method which suffices for every instance. Each case is a law unto itself. I believe, on rare occasions, in bloodletting. It is appropriate when there are a full, bounding pulse, severe headache, great dyspnœa, and cutting pain in the side. Too often, however, the patient has a feeble, fluttering pulse, which disallows this procedure. Suppose you decide to open a vein, how much blood should be withdrawn? Never, I may say, less than sixteen ounces; but the amount must be regulated by the effect on the pulse and respirations, as well

as the general systemic condition. Bleeding from the arm is much less formidable and painful to the patient than wet cupping, and, in case you decide to bleed, I would advise that you choose the direct method of extracting the blood from a vein. If the decision be against bleeding, then dry cupping is always in order. It at least can do no harm, and is often very comforting to the patient, for a while at any rate. It may be repeated daily or oftener during a limited time. Other local treatment consists in two measures of opposite nature. The hot poultice, formerly so popular, has been less used of late, and has been largely superseded by ice-cold applications. Both are palliatives probably, but there are indications that call for each. When fever is decidedly present,—say, 102° F., or above,—I prefer the ice poultice, which I always remove as soon as the temperature falls to 100° and return when it again rises. In a few cases the pain is best relieved by heat, and, when the fever is slight, I sometimes still use it. Cold may also be applied by wrapping the patient in sheets wrung out in iced water or by laying on rubber bags filled with crushed ice.

Most important is the general treatment, which is directed towards strengthening the heart and the muscular and nervous systems. Strychnine may be used in doses of one-thirtieth of a grain every three or four hours as required. I have often given, for a time, one-twentieth of a grain every four hours. Quinine and alcohol are both important cardiac tonics. There is no disease in which I start stimulation earlier. Later on, recourse may be had to digitalis, but it should be given always with care. Its use is to steady the heart. As the disease advances hypodermic injections of strychnine and digitalis in combination may tide the patient over a dangerous period. Usually the administration of digitalis when the lung is as solid as a stone is comparable to whipping a horse that is already unable to move his load. A cough medicine is prescribed in pneumonia for two reasons,—to relieve the patient from the nagging effect of the cough and to assist in raising the expectoration. For the former purpose there is nothing so satisfactory as the hypodermic injection of morphine in the smallest quantities which will meet the indication. When resolution is established, you can use the expectorant class of drugs,—ammonium carbonate (five grains) or the aromatic spirit of ammonia (twenty to thirty minims), and whiskey may be employed to assist in expelling the softened exudate.

Bloodletting may be of distinct service either at the beginning of pneumonia, when the intense pulmonary congestion and severe pain are prominent features, or after the disease has been present for some time and the right heart has become exhausted and dilated. When cyanosis and impending dissolution demand speedy measures of relief, bleeding may prove most beneficial. Only this morning I saw a young man in such a desperate condition. The lividity of his lips, the rapid breathing, and the physical condition of his lungs pointed to intense embarrassment of the pulmonary system. Oxygen gave him some relief. His pulse was quite good. After we had withdrawn sixteen ounces of blood, his pulse was, if anything, better than when we began. Our only regret was that we had not allowed a greater quantity to flow from his vein. We gave him at the same time one-sixtieth of a grain of nitroglycerin and one-hundredth of a grain of atropine hypodermically. On returning from the next room, to which we had retired for consultation, the relief was evident. The râles and rattling were no longer heard, while the lips were red and cyanosis had disappeared. Recently hypodermoclysis simultaneous with bloodletting and oxygen inhalation has been followed with the happiest results, and I can add my testimony from experience in its favor.

At the present day blistering is not usual; occasionally, however, it is helpful. When resolution is delayed or pleuropneumonia present and other active measures are impossible, a blister often has decided value. Turpentine may also be used as a counterirritant and to relieve pain. Ice-cold applications are more in vogue, but there is some difficulty in keeping them in place. In the University Hospital we make a bag out of thin rubber gauze and fill it with sawdust and broken ice. This gauze, when dampened with turpentine, will adhere. We moisten the edges, and when the bag is to be refilled simply cut away the adherent points.

Finally, is serotherapy going to be of use in the treatment of pneumonia? Reasoning from analogy and experiment, it ought to be. Practically, the question is *sub judice*. The principle of its use is briefly this. A human being, with an infectious disease, is being poisoned by a toxin formed by the invading micro-organisms. At the same time the system is generating an antitoxin. If the patient gets well, it is because the latter has sufficiently accumulated to counteract or destroy the former. The antitoxin for the serum

treatment of pneumonia is made by injecting, in gradually ascending doses, cultures of the pneumococcus into animals. When ready for use, the serum is administered by hypodermic injection in doses of twenty cubic centimetres. The effect is, in a word, the production of an artificial crisis, with its incident events, including comfort to the patient. This good result, however, is not usually permanent. Until the fever remains in abeyance, the antitoxin must be reinjected every few hours. It has, therefore, to be used from two to six times a day. I have as yet had little experience with the serum treatment, but am now using it in every case in which it is possible. Thus far I have used it in ten consecutive cases without a death. I have not, however, depended on it alone, but have added such other treatment as seemed indicated. In one of these, a desperate case, I used bloodletting, hypodermoclysis, and oxygen.

ACTINOMYCOSIS OF THE RESPIRATORY TRACT.

BY LUDVIG HEKTOEN, M.D.,

Professor of Pathology in the Rush Medical College, of Chicago.

Actinomycosis of the respiratory tract is observed almost without exception as a bronchopulmonary or pleuropulmonary process. The only reference to laryngeal actinomycosis, so far as I have observed, is by Remys, who describes yellowish-white actinomycotic granulations on the mucous membrane of the larynx of a patient with pulmonary actinomycosis, the sputum containing actinomycelial kernels. Pulmonary and secondary cervical actinomycotic foci may give origin to perilaryngeal and epilaryngeal infiltrations, but apparently, up to this time at any rate, without extensive destruction of the laryngeal structures proper (Poli, Blak). The trachea may become involved by foci in the anterior wall of the œsophagus (Poncet and Bérard).

The case from which Garten obtained his *Cladothrix liquefaciens* No. II (subsequently regarded by Gasperini and others as *Actinomyces albus*) appeared as an abdominal actinomycosis with recurrent abscess formation in the lumbar region. The autopsy showed that from an opening in the trachea there extended an abscess-cavity along the dorsal and lumbar spine down to the sacrum, with perforation of the ribs and erosion of the vertebræ. The abscess presented thick walls covered by a spongy granulation tissue.

Canali's unique case of actinomycotic bronchitis still remains without a parallel; it is the only recorded case in which the actinomycotic process developed upon the mucous surface of the respiratory tract without leading to more deep-seated lesions, so far as could be determined by physical examination. The final result of this case is, however, unknown. According to Poncet and Bérard, recovery took place. It concerned a girl, fifteen years old, who suffered from the symptoms of catarrhal bronchitis for seven years before coming under observation; the foul, viscid, yellow sputum contained actinomycelial granules. The symptoms began while mowing hay.

Routes of Infection.—Actinomycotic infection of the lungs may originate in various ways: 1. By inhalation or aspiration of the micro-organisms, either alone or fastened upon vegetable particles or other foreign bodies,—the bronchopulmonary form. 2. By extension to the pleura and lungs from without, as, for instance, from the mediastinal spaces, the œsophagus, and the abdominal organs, —the pleuropulmonary form. 3. By metastasis through the blood-vessels,—the embolic or metastatic form.

The majority of the cases of pulmonary actinomycosis probably belongs to the first group,—the bronchopulmonary form,—but in the advanced cases the changes may be so extensive and complicated that it is no longer possible to trace the cause of the lesions. Undoubtedly vegetable particles, such as the dust which arises in threshing and in handling various kinds of fodder, may convey the parasite into the bronchi. In a number of instances the first symptoms of the disease began soon after the patient had been threshing grain or handling hay, as in the cases of Buzzi and Conti, Illich, and Boström. In an actinomycotic cavity in the left apex Birch-Hirschfeld found a barley-beard covered with the characteristic mycelium. Canali's unique case of bronchial actinomycosis is also most likely an example of infection by inhalation.

Israel rather insists upon the importance of aspiration of the fungus, alone or on foreign bodies, from the mouth and the pharynx. In one of his cases he found a bit of a carious tooth in a pulmonary actinomycotic focus. Aschoff demonstrated actinomycelial granules in the teeth and Baumgarten in the tonsil in the case of primary lung disease which each reports.

As the actinomyces may penetrate a mucous membrane and give rise to adjacent foci without leaving any trace at the point of primary invasion, it is thought that in some cases of actinomycosis of the lungs the parasite may have reached the pulmonary tissue by passing through the walls of the œsophagus without permanent changes in the latter to show the course of the early events. Poncet and Bérard are inclined to lay much stress upon this mode of infection, which it would be very difficult to distinguish from the primary bronchopulmonary form, as emphasized by Boström, and they cite the insidious character of the early course of the disease, often without any pulmonary symptoms, and the frequency of secondary infection of closed actinomycotic foci as indications of

penetration through the œsophagus. On the other hand, it may be urged that the slow evolution of the disease and the often insignificant lesions of the lungs proper in apparently primary and direct infections depend upon the power of the vascular lung tissue to withstand the action of the perhaps at first feebly parasitic organism.

The lungs frequently become invaded by extension from other organs in such a way that there can be no doubt as to the manner of invasion. Poncet and Bérard propose to call the cases that originate from direct extension pleuropulmonary.

Cervicofacial actinomycosis may extend into the pleura and lungs by progressive infiltration of the tissues of the neck and, more commonly, of the prevertebral space; abdominal actinomycosis invades the lungs by extension through the diaphragm from the retroperitoneal tissue and the liver; œsophageal actinomycosis reaches the lungs by way of the mediastinal spaces or by tracheal perforation (Poncet and Bérard); finally, actinomycosis of the thoracic cage, of the spinal column, or of the skin and subcutaneous tissue, primary or secondary, may extend to the pleura and the lungs; this may occur as part and parcel of a process already more or less intimately associated with the lungs, and in advanced cases of thoracic actinomycosis it may be quite a problem to decipher the exact course of events from either the clinical or the anatomical point of view.

Naturally the lungs are commonly involved in the pyæmic form of actinomycosis, because the pulmonary capillaries will be the first capillary net-work reached by the emboli in the majority of cases.

Pathological Anatomy.—Israel distinguishes three stages in the lesions of pulmonary actinomycosis: first, the lung tissue only is involved; second, the invasion of the pleura and adjacent organs; third, the involvement of the thoracic wall. These stages correspond fairly well with the clinical course of many cases, but from the etiological and anatomical point of view it does not apply as well to the cases of invasion of the lung from without. Poncet and Bérard, in their "Traité clinique de la Actinomycose," consequently prefer the subdivision of Pic and Naussac into the bronchopulmonary and pleuropulmonary forms, according as the lungs or the pleuræ are the more involved. This arrangement also has the advantage of corresponding more closely to the two essential routes

of invasion,—namely, the bronchi and the mediastinum. From this aspect Israel's three periods are strictly applicable only to the bronchopneumonic group. As already stated, the advanced cases, whatever the road of infection, may present not only the same histological changes but also identical anatomical appearances, because when the lung is invaded from without the bronchi are soon attacked, and the process spreads in the lung in the same manner as in the primary bronchopneumonic form, and the latter mode of infection, as well as the embolic, soon leads to the same pleural and peripleural changes as in the pleuropneumonic variety. The distinction between the bronchopneumonic and the pleuropneumonic forms is therefore, in the majority of cases, in reality applicable only in the etiological sense and otherwise at most only in the early or but slightly advanced instances.

1. *Actinomycotic Bronchopneumonia.*—When the parasite lodges in the bronchi, the consecutive changes, briefly speaking, begin as a progressive bronchitis and bronchopneumonia, associated with exudation and epithelial desquamation and proliferation, followed by the invasion of the submucous and peribronchial connective tissue, resulting in areas of characteristic actinomycotic granulation tissue and islands of purulent softening, succeeded by more or less extensive cavity formation with fistulous and burrowing canals, and fibrous indurations with shrinking of the affected lobe. Sooner or later the lesions reach the vicinity of the pleura, causing at first a simple serous or serofibrinous exudate, followed before long by extensive and thick pleuritic proliferations and adhesions, tunnelled by tortuous fistulous canals and enclosing larger and smaller actinomycotic cavities. Soon the peripleural tissues and the structures of the thoracic wall become involved in the lesions, and in the same general manner the process may extend to the other intrathoracic organs and tissues.

2. *Actinomycotic Pleuropneumonia.*—When the lung is invaded from without, which most frequently takes place from the mediastinum and the œsophagus, there result pleural thickenings and adhesions, enclosing fistulous canals and sacculated cavities, filled with a serous or purulent exudate, and more or less extensive infiltrations, with foci of disintegration and bands and areas of indurating scar tissue, the lesions being in the main similar to those described in the first form.

The anatomical appearances of the actinomycotic lung vary greatly, depending upon the extent, the age, and the intensity of the lesions. It is, therefore, difficult to give a succinct description which shall include all possible details.

In the majority of cases the process involves principally one or other of the lower lobes. In West's series of twenty-seven primary cases the lower lobe of the left lung was by far the commonest locality of the primary disease.

There are practically always more or less extensive pleural changes, in the early stages exudative, later suppurative and principally productive and retractive.

The affected lobe often appears carnified, shrunken, or collapsed in parts or throughout the whole of its extent. On the cut surface the essential feature in all cases is the presence of disseminated soft foci of a pale-red or yellow color, smaller or larger abscess-cavities and fistulous canals, containing the yellow kernels, situated in recent vascular or older and indurated fibrous tissue. In the individual case one or other of these lesions may predominate. A continuous area of varying extent up to one lobe or more may be involved, or there may be scattered foci. In the latter instance there are seen on the cut surface islands of bluish-red fibrous tissue, with reddish or yellowish centres, enclosing the fungus in more or less softened detritus; in many cases the softer centre of the area will be found to correspond to the lumen of a bronchus; in other places will be seen irregularly formed, bean-sized and smaller, as well as larger, cavities, with anfractuous walls, which, rarely smooth, are lined by an apparently disintegrating, grayish or yellowish tissue, which merges gradually into a firmer tissue in which spots of brownish-red color betoken older or more recent hemorrhages; the cavities generally communicate with one another, with the lumina of the bronchi, and in some cases with foci in the chest wall, by means of sinuous and slit-shaped fistulous passages, which run in all directions and contain exudate, débris, and fungi.[1]

---

[1] The sputum in pulmonary actinomycosis has been found to contain actinomycelial granules by a large number of observers (Adler, Butler, Canali, Geisler-Jänicke, Ginsberg, Halban, Heuck, Heusser, Jakimovitsch, Kopfstein, Laker, Lindt, Rotter, Sokoloff, Szenasy, and others). Lösch, in a number of cases of pneumonia, found masses of fat-crystals which resembled somewhat fungous clusters. The sputum of pulmonary actinomycosis is often bloody, more like the sputum of malignant tumors than that of tuberculosis.

The process may show unmistakable signs of spreading, by way of the bronchi, from an older focus or area, situated perhaps in the upper part of the lung and composed of whitish cicatricial bands, enclosing numerous small cavities, filled with a mucopurulent fluid and granules; in the inferior parts of the same lobe, as well as in the lower lobes, may be several yellowish-white foci, perhaps as large as a hazel-nut, resembling very much tuberculous bronchopneumonic foci, closer examination, however, revealing their actinomycotic nature.

The tendency of actinomycosis to wander by peripheral extension, as the earlier lesions heal by cicatrization and perhaps calcification of the abscess-cavities including the fungous granules, is well illustrated by the pulmonary localization. Thus, an entire lobe or a part of one may be found changed into branching bands and diffuse masses of connective tissue containing shrunken abscesses and small calcareous foci, while the active seat of the disease may be in the chest wall, to which it is traced from the lung by fistulous tracts, cicatricial bands, and adhesions. This actinomycotic cirrhosis of the lung is frequently clinically latent in its early stages; anatomically the march of the process is indicated by its scarred and indurated path through the tissues. In some instances of this kind the amount of lung tissue involved may be quite small. Thus, Illich describes a case of primary pulmonary actinomycosis in the right lower lobe, which was bound down to the chest wall over its posterior and outer aspects by cicatricial adhesions, one centimetre thick, perforated by numerous fistulous passages, lined with soft granulation tissue and filled with pus and numerous granules. The adjacent lung was replaced by scar tissue, also about one centimetre thick, and the neighboring parenchyma contained gray nodular areas with a yellow centre. From the pleura extensive bands of scar tissue, enclosing fistulous passages, extended through the diaphragm and the muscles of the back, down to the upper half of the right kidney, which was adherent to the scar, as was also the liver.

In König's case of the pyæmic form James Israel traced the extensive and numerous metastases to a limited cicatricial area, traversed by bean-sized abscesses, in the anterior margin of the right lung, whence the process had extended to the heart muscle.

Large cavities are rare in actinomycosis of the lungs. Richard

Paltauf describes one, as large as an apple, in the lower left lobe, surrounded by indurated tissue which contained smaller actinomycotic abscesses and minute yellow foci; there was also an actinomycotic pleuritis, from which fistulæ passed through the intercostal muscles into an enormous abscess-cavity in tissues of the back. Lindt describes cavities with thick, yellow actinomycotic pus in both apices, and similar caverns as large as an orange have been observed in the lower lobes.

A miliary pulmonary actinomycosis, such as described by Pflug and Munch, in cattle, is infrequent in man; West refers to three cases in which had taken place a kind of miliary dissemination, principally of the healthy parts of the diseased lung, and in the form of small actinomycotic bronchopneumonic patches, which, when small, look like miliary tubercles.

Histology.—The general histology of actinomycosis is virtually the same in all tissues; the histological lesions are more or less modified, however, by the peculiar structure of the organs affected. Thus, in the lungs there develops, according to Hodenpyl and others, an exudative and desquamative bronchitis and bronchopneumonia; some of the smaller bronchi are changed into little abscesses containing the fungous granules, many perhaps calcified; the air-vesicles become filled with desquamated cells, polymorphonuclear leucocytes, and fibrin; according to Abbée, the presence of the actinomyces in the air-vesicle, due to aspiration or otherwise, induces also the formation of giant cells of the tuberculous type, from the desquamated and proliferated epithelial cells. The zone of new-formed granulation tissue in and about bronchial and alveolar walls undergoes granular and fatty degeneration, at the same time as the elastic elements of the stroma of the lung are dissolved, under the influence of some ferment peculiar to actinomycosis. This may explain why elastic fibres are so rarely, or not at all, observed in the sputum of actinomycosis of the lungs. This disintegrating layer gradually merges into a cellular and vascular young connective tissue, from the embryonal vessels of which small hemorrhages may take place.

In a case of long standing Walker found the alveoli oblong and represented by small cysts or gland-like cavities lined with cubical epithelium. Corpora amylacea surrounded by giant cells were present in some alveoli.

Kind of Organisms observed and Mixed Infection.—The importance of mixed infection in causing the changes observed in pulmonary actinomycosis has not yet been determined. The part played in the formation of abscesses and cavities by the pus cocci (*Staphylococcus pyogenes aureus* and *Streptococcus pyogenes*), observed among others by Hodenpyl in pulmonary actinomycosis, has not been accurately studied. Abbée believes that the essential lesions may occur without any mixed infection.

Atypical, polymorphous ray-fungi have been found rather frequently in pulmonary actinomycosis; such have been isolated by Wolff and Israel, Kischensky, Aschoff, and Berestneff. Tchegeloff isolated the *Actinomyces albido-fuscus.* Thoracic actinomycosis is therefore not an etiological entity. Processes, resembling more tuberculosis than typical actinomycosis, and caused by branching, acid-proof organisms, have been described by Scheele and Petruschky, Flexner, Norris, Larkin, and others.

Extension to Other Organs.—It is rare that the process remains confined to the lung; as it extends the pleura, peripleural tissues, and other parts of the walls of the chest cavity become earliest involved and most frequently. In a given case the structures secondarily invaded by extension naturally depend somewhat upon the part of the lungs primarily involved. To be more specific, intrathoracic actinomycosis may extend to the spinal column, the mediastinum, the pericardium and the heart, the diaphragm, the liver, the spleen, the retroperitoneal tissue, the venæ cavæ, the ribs, the sternum, the mammary glands, and the tissues of the neck.

In not a few cases of pulmonary and thoracic actinomycosis metastasis by way of the blood-current has developed.

Fig. 1 shows a bovine lung containing abscesses and numerous transverse bands of connective tissue.

FIG. 1.—Actinomycosis of the bovine lung, showing abscesses in tissue crossed by fibrous bands.

SOME RELATIONS OF OSMOSIS AND IONIC ACTION IN CLINICAL MEDICINE.[1]

BY HENRY SEWALL, Ph.D., M.D.,
Denver, Colorado.

ONLY a few years have passed since the average practical physician or surgeon was wont to view with a limited tolerance mixed with contempt any serious consideration on the part of his cult of theories attempting to explain vital phenomena. It is true that nearly all important advances in medical art, not to say science, have been founded directly upon the laboratory work of the thinker *per se;* but it is the surest sign of the real advance in medical education recently achieved in this country that now, as never before, the practical clinician regards the laboratory as the culture house for his ideas, and is even prone to inquire into the physics, chemistry, physiology, and pathology of the vital phenomena that engage him. It is pleasant also to observe that in this new era Americans are doing their full share in the development of science. Since, more than ever, to-day our chief advances have their forerunners in laboratory research, it seems wise that now and then we should put our "ear to the ground," as the saying is, to anticipate the coming of new hosts of ideas. I have, therefore, ventured to present to you, imperfectly and in outline, a theme which during the last five or six years has gained a new significance, which is now modifying our conceptions in every field of physiology, which directs the bedside practice of every clinician, and which promises in the future to give us such control over vital processes as have hitherto been undreamed of. I shall attempt to touch upon some relations of osmosis and ionic action to the phenomena of health and disease.

As the physical facts and theories at the basis of this subject are more recent than the undergraduate days of most of you, I must ask your indulgence for a few words of definition. Our student

[1] Read by request at the meeting of the Kansas Medical Society, May, 1901.

days made us familiar with the classification of substances soluble in water into two groups, colloids and crystalloids, typical examples of the first group being found in gelatin and the white of egg and of the second in salt and sugar. We remember the familiar demonstration in which a mixture of these substances was enclosed in a tube of parchment-paper or of animal membrane, which was then immersed in pure water so that the level of the two fluids should allow no difference of hydrostatic pressure. We remember that the salt and sugar passed out through the membrane into the water until its percentage was equal on the two sides; conversely, the pure water passed into the membranous tube. This process of mixture was called *dialysis* or *diffusion,* and the animal or parchment membrane was evidently *permeable* to the crystalloid though not to the colloid albumin or gelatin, which remained behind in its receptacle. The term *osmosis* was also applied to this process of diffusion through a membrane, though recently this expression has gained a very peculiar significance, for it has been restricted to indicate those conditions in which the diffusion membrane is of such fine texture that it allows the passage of a water molecule but retains all other molecules, even those of salt and sugar.[1] Such a fine sieve is called a "semi-permeable" membrane, and may be constructed with nearly theoretical perfection by special technical methods.

Suppose a cylinder composed of such a membrane be surrounded by pure water. Pour into the cylinder a one per cent. watery solution of cane sugar until the hydrostatic pressures of the two fluids balance. The pure water begins at once to dialyze through the membrane into the sugar solution, but no sugar passes in the contrary direction. By this means the hydrostatic pressure of the sugar solution increases, and continues to increase up to a certain value, which is determined by the number of molecules of sugar per volume in solution. This excess of pressure generated within the cylinder containing the sugar solution is known as *osmotic pressure.* In the case of a one per cent. solution of cane sugar the osmotic pressure would equal 0.65 of an atmosphere, or 494 mm. Hg. Did our solution contain 34.21 per cent. of sugar (or a number of grammes representing its atomic weight in a litre) the os-

---

[1] Cf. Howell, American Text-Book of Physiology, 1900, i. 65; also, E. Waymouth Reid, Schaefer's Text-Book of Physiology, 1898, i. 261.

motic pressure would reach the enormous value of 22.32 atmospheres. These extraordinary pressures are believed to be due to the molecular energy of the vibrating molecules. The oscillating molecules of pure water pass readily through the membrane in either direction; but the molecules of sugar cannot permeate the membrane, and they may be supposed to shield the membrane on their own side from the impact of a certain proportion of water molecules; the resultant stream is, therefore, in the direction of the sugar solution. Every substance dissolved in water is capable of exerting a definite osmotic pressure or, to use the old, erroneous expression, exerts a definite attracting force on pure water. When two solutions are separated by a semi-permeable membrane, water accumulates on the side of the solution having the highest osmotic pressure. When two solutions have the same osmotic pressure, neither will lose or gain water, and they are said to be *isotonic* or *isosmotic* to each other. In other conditions, the solution having the highest osmotic pressure gains water, and is said to be *hypertonic* to the solution which loses water and is therefore *hypotonic.* Thus, as will be seen later, a 0.7 per cent. sodium chloride solution is called the "physiological salt solution," because it is supposed to be isotonic or indifferent to the living tissues. As a matter of fact, a little consideration will show that every cell and fluid in the body probably has its specific osmotic pressure, with a consequent variation in the concentration of the sodium chloride solution isotonic with it.

As all osmotic interchanges in the body depend upon the osmotic pressures or tonicities of the interacting substances, the determination of these tonicities is of the utmost importance. It may be repeated that the osmotic pressure of a given substance is proportional to the number of molecules per volume of solution. The freezing point of a solution is lowered in proportion to the number of molecules of the dissolved substance per volume; hence the ordinary mode of estimating the osmotic pressures of different solutions is by comparison of their freezing points.

A very important modification of the laws of osmosis is involved if instead of such a substance as sugar we use as the attracting medium another crystalloid, such as common salt. This substance belongs to a chemical group the members of which when in solution conduct an electric current and are decomposed by it, one of the

constituents being set free at the positive pole and the other at the negative. They are known as electrolytes, and, in general, may be said to include all salts, bases, and acids. It is now a generally accepted theory that when an electrolyte is brought into solution its molecules become dissociated into two or more parts, which are known as *ions,* and are identical with the bodies resulting from the decomposition of the electrolyte by the passage of a galvanic current. The number of molecules which are thus dissociated increases with the dilution and, each ion behaving as an independent molecule, the osmotic pressure of such a solution varies not only with the weight of salt dissolved but with the degree of dilution. Take, for example, a molecule of sodium chloride; dissolved in water it becomes dissociated into a sodium ion charged positively with electricity and a chlorine ion charged negatively. A solution of common salt, consequently, comes to have a new significance as a solution of sodium and chlorine ions whose physical attractions and repulsions for each other and for other substances in solution are determined by their respective electric charges.

The theory of ions, so far from remaining a pure abstraction, has already served as a working hypothesis in much valuable biological research. Observers have agreed that very weak solutions of mineral salts have most important relations to the activities of living matter, and the facts seem to show that these salts act on protoplasm not as compounds, but through their ions. Thus, when a strip of muscle cut out from the apex of the heart is suspended in a weak solution of the chlorides of sodium, potassium, calcium, and magnesium, rhythmic contractions are started or brought to a rest, are made stronger or weaker, according as the proportion of one or another of the ingredients of the solution is increased or diminished.[1] The automatic contractions of certain marine jelly-fishes are similarly modified by the composition of the water in which they move.[2] Such effects can depend only upon variation of the metallic ions of the compounds. The physiologist Loeb, of Chicago, has shown reason for believing that the various metallic ions, sodium, calcium, potassium, magnesium, etc., form compounds with the proteids of living matter and are individually

---

[1] Cf. Howell, American Journal of Physiology, 1898, ii. 47.

[2] Loeb, American Journal of Physiology, 1900, iii. 383.

poisonous to it, but that, in proper proportions, they neutralize the harmful influence of one another, so that only a helpful, stimulating effect is the result.[1] Loeb shows that skeletal muscles contract rhythmically in a pure sodium chloride solution, but that the presence of calcium and potassium ions prevents such automatism.[2] He has demonstrated that pure sodium chloride is deadly to living tissue, but that the poisonous effect is counteracted by minute quantities of calcium and potassium ions.[3] Many observations lead to the conclusion that the irritability of muscle and nerve depend upon the presence in them of compounds of proteid with the various ions sodium, potassium, and calcium in definite proportion.

We have thus far considered the vital relations of the negative or basic ions called *kations* because set free at the negative pole when decomposed by a galvanic current. The positively charged acid ions, or *anions*, have also certain physiological relations. Thus, Wallace and Cushney, of Ann Arbor, and others have found that the rate of absorption of the salts of the fixed alkalies from the intestine varies with the anion, or acid ion.[4]

As far back as 1864, a chemist, Newlands, found that the chemical and physical properties of the elements had some inherent relation to their atomic weight.[5] He was able to divide all known chemical elements into ten groups, between the members of which there is a close resemblance in their chemical properties and a certain numerical relation between their atomic weights. Pursuing this idea, Mendelejeff pointed out a vacancy in a series of elements grouped according to the atomic theory, and announced that the then unknown element belonging in this place must have certain stated physical and chemical characters. This prediction was later verified by the discovery of the element Gallium.

It has been made certain that a close relation exists between the chemical constitution and the physiological action of drugs, and the effective factor seems to be the atomic weight of the constituent atoms. The physiological activity of certain chemical groups has been found to vary directly and of others inversely as the atomic

[1] Loeb, American Journal of Physiology, 1900, iii. 327.
[2] Loeb (reference), Festschrift f. A. Fick, Braunschweig, 1899.
[3] Loeb, American Journal of Physiology, 1900, iii. 327.
[4] Wallace and Cushney, American Journal of Physiology, 1898, i. 411.
[5] Brunton, Pharmacology and Therapeutics, 1888, pp. 16–32.

weights of the reacting elements. Experiment has proved that the physiological effects of certain drugs can be modified in definite ways by addition of chosen radicles to the molecule. Thus, the convulsive action of strychnine, brucine, and thebaine on the spinal cord is changed to a paralyzing effect by the introduction of *methyl* into the molecule.[1] Recently Marshall and Heath have shown that the introduction of chlorine atoms into certain fatty molecules increases their narcotic and toxic powers.[2]

Now, the osmotic pressure of any substance in solution has a definite relation to its atomic weight, and it is easy to believe that the new conception of physiological chemistry, according to which chemical or physical activity of electrolytes is referred to those atoms or groups of atoms known as *ions*, discloses a new territory whose exploration promises to reveal many secrets of the chemical and physical relations of inorganic to living nature. Certain kinds of infusoria when exposed to light, or when a galvanic current is passed through the water containing them, arrange themselves in definite groups, determined by the direction of the current or of the luminous rays. Garrey[3] has recently shown that the attractions and repulsions causing this definite grouping of living organisms can be completely paralleled by the *ionic* action of chemical substances dissolved in the water inhabited by the creatures. The suspicion at once springs up that the rouleau formation of blood-corpuscles, the agglutination of bacteria in appropriate media, and the obscure facts of chemotaxis, illustrated by the attraction or repulsion which certain chemical media have for some bacteria and for leucocytes, have their explanation in the forces of ionic attraction and repulsion.

Strong has recently elaborated a physical theory of nerve and nerve action based on the assumption that the axis-cylinder contains negative and positive ions of different degrees of mobility.[4]

Turning to another phase of the subject, the trophic action of the nerve-cell in maintaining the nutrition of the nerve-fibre has been explained by assuming that the passage of a nervous impulse so alters the osmotic properties of the axis-cylinder as to accelerate the

---

[1] Brunton, Pharmacology and Therapeutics, 1888, pp. 16–32.
[2] Marshall and Heath, Journal of Physiology, 1897, xxii. 38.
[3] Garrey, American Journal of Physiology, 1900, iii. 291.
[4] Strong, Journal of Physiology, 1900, xxv. 427.

imbibition and assimilation of nutritive material by it. Cooke has shown that the osmotic pressure of fatigue is greater than that of fresh living muscle, and that interchange of material between the muscle-fibre and the lymph bathing is probably thus brought about.[1]

Loeb has drawn attention to the capacity for absorbing water manifested by different soaps.[2] "While potassium soaps absorb enormous quantities of water, the sodium soaps absorb much less, and the calcium soap still less than the sodium soaps. If in the sodium soaps we substitute potassium ions for the sodium ions, the soap takes up quantities of water. If we substitute calcium ions for sodium ions, the soap loses water." He argues that the variable capacity of protoplasm for the absorption of water depends upon the nature of the ions in its proteid molecules. According to him the phenomena of *growth* depend upon the increase of osmotic pressure consequent upon the chemical dissociations due to muscular work.[3]

A wonderful demonstration of the efficacy of osmotic force in modifying vital activity had been furnished by Loeb in his experiments on artificial parthenogenesis.[4] It was found that the eggs of a marine animal known as the sea-urchin, which ordinarily develop only after fertilization with spermatozoa, can be stimulated not only to undergo segmentation, but even to develop into complex and normal larvæ, by placing them for two hours in sea water made denser by the addition of a certain percentage of chloride of magnesium, after which they are returned to normal sea water. The stimulus to the activity of the protoplasm in this case seems to be the drying due to the loss of water by osmosis. In another direction, it has been shown that the irritability of muscle is, to a certain extent, proportional to the amount of water absorbed by osmosis.

Let us now transfer some of the principles involved in these necessarily rambling statements to the working of the living body as we commonly regard it. The active tissues of the body contain a very large proportion of water, varying from about eighty per cent. in the blood to about seventy-five per cent. in the muscles. Physical continuity between these media is established by the intercellular and intracellular lymph. Experiment shows, what might have been

[1] Cooke, Journal of Physiology, 1898, xxiii. 137.
[2] Loeb, American Journal of Physiology, 1900, iii, 327.
[3] Loeb (reference), Archiv f. d. ges. Physiologie, 1894, lvi. 567.
[4] Loeb, American Journal of Physiology, 1900, iii. 434.

expected, that the normal distribution of water between blood, lymph, and solid tissues is maintained through the nicest physiological adjustment, whose direct working factor is probably the force of osmosis. When the blood loses water, this is replaced by fluid drawn from the lymph, which in turn makes good its loss from the solid tissues. If a concentrated salt or sugar solution is injected into the vein of a living animal, the osmotic pressure of the blood is thereby increased and a stream of water oozes in through the capillary walls and dilutes the blood.[1] The hydræmic plethora thus produced, in some way, possibly through rise of intracapillary pressure and elevation of filtration force, causes an increased transudation through the capillary walls, leading to an increase in the force and volume of the lymph-current and in the activity of renal secretion until the original composition of the blood-fluid is regained.

When a dilute solution, as of sodium chloride, having lower osmotic pressure than the blood, is introduced in excess into a vein the hydræmic plethora thus produced begins at once to diminish, owing to the rapid transudation of the fluid through the capillary walls, not of the muscles, but of the intestines and peritoneum.[2]

Osmotic interchange between solutions predicates that they are separated by a membrane which is permeable to water but impermeable to substances dissolved in it. Now, the capillary wall, forming the membrane which separates the blood from the lymph, is not a membrane of this character, but allows filtration due to difference of hydrostatic pressure as well as diffusion of substances in solution to pass through it. In the interchange of bodily fluids, therefore, the forces of filtration and diffusion complicate those of osmosis in the transference of material. Moreover, the membrane of separation in the body is a *living* membrane. Physiologists are divided in opinion as to whether the vital attributes of the capillary wall determine the passage of material through it according to principles other than those involved in physical law. Heidenhain and his school maintain a selective absorbing and secreting power on the part of the living capillary epithelium, aside from the recognized effects of osmotic pressure. Other observers maintain that all transudation finds its basis in the action of the physical forces men-

---

[1] Starling, Schaefer's Text-Book of Physiology, 295.

[2] Sherrington and Copeman, Journal of Physiology, xiv. 52.

tioned. Much may be said on the side of the vitalistic theory of Heidenhain, and the abundant nerve supply of the capillaries demonstrated by Sihler,[1] of Cleveland, lends strength to the notion that their walls are in all relations under central nerve control. It has been shown that the capillaries of different vascular districts in the body are differently permeable to their contents. Thus, as determined by the volume of lymph-flow in different situations, the capillaries of different organs may be arranged in a series according to their permeability. On this scale the capillaries of the liver show the greatest permeability, those of the muscles the least, with the intestinal vessels midway between them.[2] If we but suppose that the physiological or vital activity of the capillary wall is capable of varying its permeability as a membrane, just as the osmotic pressure of a muscle is modified by its activity, we shall have an explanation of the physiological adjustments of transudation and also of many of the facts of œdema as we know them in medical practice.

From all that has gone before, it is evident that the facts of osmosis and the ionic theory have the most intimate relations to the sum total of vital processes. The application of the truths of physiology and of the laws of chemistry and physics to the explanation of clinical phenomena is always to be made with caution, but I will attempt to extract from our familiar experience illustrations of the vital importance of the doctrines of osmosis in medical and surgical practice. The condition of *collapse,* which is the remote effect to be feared in surgical operations on the abdomen, in hemorrhages, and in the course of diseases such as cholera, in which vomiting and diarrhœa are prominent symptoms, depends for its pathology on the abstraction of water from the circulation.

In explanation of the necessity for the maintenance of a certain volume of fluid within the blood-vessels, I must recall to you the physiological fact that the heart is only the remote cause of the circulation of the blood; the arterial blood-pressure is the immediate cause. Cardiac and vasomotor activities combine to maintain a certain average height of general arterial pressure, for on this depends the nourishment of every living cell in the body. Many active tissues, as the glands, intestines, and muscles, may vary enormously

---

[1] Sihler, Journal of Experimental Medicine, 1901, v. 493.
[2] Starling, Schaefer's Text-Book of Physiology, 295.

in their watery contents without abolition of their physiological activity, and a certain loss of fluid from the general circulation can be compensated by more rapid heart-beat and increased vascular tone, but the limits of the adjusting mechanism can be easily overstepped. Continued loss of vascular fluid must mean gradual exhaustion of the cardiac and vasomotor mechanisms in their efforts to maintain a working head of pressure, and with this failure results asthenia of the nervous centres from deprivation of oxygen and other nutriment. At the same time, concentration of the blood probably leads to clogging of capillaries by the crowding corpuscles.

Interesting light was thrown on the nature of collapse by experiments conducted by Roy and Cobbett.[1] These observers operated on anæsthetized dogs, producing collapse in them by opening the abdominal cavity and ligating the intestines. A continuous record was made of the arterial blood-pressure, and the distribution of fluid in the body was determined at short intervals by measuring the specific gravity of the blood and of various tissues. The authors say that "from the time the abdomen was opened, the specific gravity of the intestinal wall diminished and that of the skeletal muscles increased very considerably; but the specific gravity of the blood for an hour or two did not show any marked change." That is to say, irritation of the abdominal viscera led to an immediate outpouring of watery lymph into the intestinal tissues, due probably chiefly to increased permeability of the capillary walls as well as to increased local intracapillary pressure. This lymph must have come directly from the circulating blood, and, as the blood itself sustained its normal specific gravity, it must have derived a compensatory amount of watery fluid from the uninjured tissues, especially the muscles, which, accordingly, became drier and consequently showed an immediate rise in specific gravity. The supply of lymph in the muscles was thus gradually reduced, so that the amount leaking from the blood into the intestinal walls could not be compensated; thereupon the specific gravity of the blood began to rise and, though the normal arterial blood-pressure was maintained for a while, signs of circulation failure became manifest. Finally fall of blood-pressure began, with increasing specific gravity of the blood, and continued until the death of the animal. Could

[1] Allbutt's System of Medicine, iii. 326.

anything more perfectly portray the continuous osmotic balance determining the distribution of fluid between tissue and blood throughout the body? Previous to the time of these experiments Hamilton [1] had surmised that drying of the blood by the withdrawal from it of large quantities of water would lead to collapse by clogging the capillaries with corpuscles. The pinched features of the human victim of collapse find a ready explanation in the drying of the tissues of the face by the drainage of fluid from them. In combating collapse the familiar practice of the day is the introduction, direct or indirect, of warm salt solution into the circulation. There are few of us who have not marvelled at the almost miraculous return of vital power after such a proceeding. Too often, it is true, after sustaining life day after day by this means, we fail in the end to fan the fading spark into flame. Notwithstanding our frequent failures, the results already gained are so remarkable that we cannot but be on the right track. It may be that our excess of sodium ions forms, as held by Loeb, actual poison to the tissues, and that their toxicity might be neutralized, as he has shown, by proper admixture of calcium and potassium ions. It may be that under the conditions of collapse the tissues are gradually starved for want of nourishment. Proceeding on this hypothesis, and in view of the physiological belief that the sugar of the blood is directly appropriated by the tissues as sources of energy, I have on two occasions added pure dextrose to the saline infusion, once, at least, with apparent good effect. Roy and Cobbett found that intravenous injection of salt solution into their collapsed dogs succeeded only temporarily in reducing the specific gravity of the blood; in a short time it became as high as before. Sherrington and Copeman [2] and Lazarus-Barlow [3] have found that strong solutions of glucose, on account of its osmotic properties, maintained a lowered specific gravity of the blood for a much longer time. Many facts of experiment indicate that variations in the specific gravity of the blood give a delicate and speedy response to variations of the circulation both within and without the vascular system, and impress the thought that determination of the specific gravity of the blood should always be made in estimating the condition of patients threatened with collapse.

[1] Hamilton, Journal of Physiology, 1883, v. 66.
[2] Sherrington and Copeman, Journal of Physiology, xiv. 52.
[3] Lazarus-Barlow, Manual of Pathology.

HÆMOPTYSIS, HÆMATEMESIS, AND OTHER INTERNAL HEMORRHAGES: THEIR CAUSATION AND TREATMENT.

BY CARSTAIRS DOUGLAS, M.D., B.Sc., F.R.S. (Edin.), F.F.P. & S. (Glasgow),

Professor of Medical Jurisprudence, Anderson's College Medical School, and Director of the West of Scotland Clinical Research Laboratory, Glasgow.

Of the more serious emergencies which the physician is called upon to treat, there is perhaps none more common than internal bleeding. So indissolubly is the idea of vitality associated with the blood by the laity that any hemorrhage, however slight, proceeding from an internal source is apt to fill them with alarm, and the medical man is called in at once. No doubt, in many cases the bleeding is so trivial and the patient's health so excellent that the physician feels no cause for alarm, and, beyond calming and reassuring the patient, has no need to use active measures. But in other cases the loss of blood is so profuse and its onset so sudden that the most prompt action must be adopted if a fatal termination is to be avoided. It may, therefore, be of service if we consider in some little detail the causes and treatment of hæmoptysis, of hæmatemesis and intestinal bleeding, and, lastly, of hæmaturia.

Hæmoptysis.—The etiology of bleeding from the respiratory tract is very diverse. The minor degrees of hæmoptysis occur in congestion of the bronchial mucosa in the early stages of tubercular disease; in pressure, with erosion, exerted on a bronchus or bronchiole by a new growth, an aneurism, or a foreign body; in ulceration of the larynx and the trachea; in the first stage of pneumonia; and as a result of pulmonary engorgement as a consequence of mitral disease and increased backward pressure. In these cases the bleeding is small, is only symptomatic, and calls for no active treatment *per se*. In mitral disease, indeed, it affords relief to the over-distended left auricle, particularly in cases of stenosis. Yet every medical man is consulted time and again on account of the alarm caused to the patient by these trifling hemorrhages. His duty

in such cases is to make a careful physical examination of the chest, keeping always in mind the possibility of early tubercular disease. But in many cases absolutely no physical signs can be found, and the patient never again complains of this symptom. It is hardly necessary to prescribe for such cases, but it may be some comfort to the individual to know that he is taking something, and a mixture may be given containing in each dose from five to ten minims of dilute nitric acid, the same amount of the liquor morphinæ hydrochloridi (B. P.), and thirty minims of syrup of squills, some aromatic water being added to give the necessary bulk.

Still more free hemorrhage is met with in the case of malignant disease of the lung, the sputum often having a peculiar florid appearance and gelatinous consistence, suggestive of red-currant jelly. The bleeding here is not so free as to endanger life, and the treatment for it, as for the hopeless disease of which it is an indication, is simply palliative, by means of morphine.

There are, however, two conditions in which hæmoptysis is great and alarming. The first of these, and one which almost invariably proves fatal at once, is where an aneurism ruptures into a bronchus or into the lower part of the trachea. This accident may take place with appalling suddenness, and the patient succumbs within a few minutes from the combined effects of hemorrhage, asphyxia, and shock.

The second condition under which free hæmoptysis may occur is in pulmonary phthisis in its later stages. Mention has already been made of the slight hemorrhage of early tubercular disease; in the more advanced disease, when vomicæ are present, serious bleeding may arise from erosion of or ulceration into a large vessel lying on the wall of a cavity, or from the rupture of small aneurismal dilatations, which are very apt to form in the course of such vessels, ill-supported as they are. The loss of this amount of blood in the case of an already enfeebled and emaciated patient is a grave matter, and prompt measures must be adopted to prevent its continuance or recurrence.

Treatment of Hæmoptysis.—The patient, if not already in bed, must immediately be placed there and kept at perfect rest. It is of importance that he should lie on the affected side (Murray Leslie), as that is the one from which the bleeding comes, so that if blood regurgitates it will do so into the already useless lung and do little

further mischief. The room must be kept darkened, cool, and secluded, and conversation absolutely forbidden. All bodily exertion should be limited as far as possible, a bed-pan being used to receive the discharges from the bowels and bladder. The food must be of the most non-stimulating description, chiefly milk and barley-water; it should be administered tepid; if given ice-cold, as is often done, it constricts the gastric vessels and may thus divert more blood into the thorax. The application of an ice-cap to the chest is of doubtful utility; it may possibly do a little good by calming the heart's action and so lowering blood-pressure. The styptics commonly employed are of little or no value in hæmoptysis. Ergot should never be given, for the bleeding is usually from an artery, and that drug by its peripheral vasoconstrictor force is very apt to raise the blood-pressure and so increase the bleeding. The researches of Stockman have shown that tannic acid has no distant hæmostatic effect, and the same may be said of most of the other styptics, since they act chiefly as direct agents, producing an insoluble albuminate and so sealing the vessel. No aid can be expected from any medicine except opium or one of its preparations. By soothing the patient, preventing restlessness, and allaying cough, it may prove of incalculable benefit. One-quarter of a grain of morphine may be given by the skin, or one grain of opium, or thirty minims of laudanum or nepenthe by the mouth, and the dose repeated at the discretion of the physician. It is the sheet-anchor in this condition. The administration of gelatin by the mouth or subcutaneously, as advocated by the French school for the purpose of inducing readier coagulation of the blood, has not met with much success in hæmoptysis; we shall refer to it again. Wright's plan of administering calcium chloride in certain hemorrhages, to hasten the coagulation of the blood, is not available here, as the bleeding is dependent not on an altered condition of the blood, but on a wound in a vessel. The bowels should be cleared out as early as possible, at first by a glycerin enema or suppository, and thereafter by a saline purge, such as magnesium sulphate or Carlsbad salts.

Hæmatemesis and Intestinal Bleeding.—If we consider the causes of hemorrhage from the stomach, we find that it may arise under a great variety of circumstances. In the first place, the blood may have been swallowed, as in cases of epistaxis, hæmoptysis, bleeding from the gums, and after operations on the

nasopharynx. This common source of vomited blood must always be borne in mind. In nearly all other cases of hæmatemesis the blood comes from the stomach itself, and this is met with in the following morbid conditions: in gastric ulcer and cancer and in pinhole erosions of vessels, the bleeding in these instances being arterial and often copious; in chronic venous congestion secondary to portal thrombosis, hepatic cirrhosis, chronic pulmonary disease, and chronic valvular disease of the heart; in excessive vomiting and straining, the blood in these cases sometimes coming from the lower part of the œsophagus or from the duodenum; in this group we should perhaps include the hemorrhage which sometimes accompanies the gastric crises of locomotor ataxia and which may be very free; in certain blood diseases, such as scorbutus, purpura hæmorrhagica, leucocythæmia, and hæmophilia; in cases where corrosive poisons have been swallowed; and, lastly, in those rare instances of vicarious menstruation.

In making a diagnosis in such cases there are several practical points to be kept in mind. To begin with, the patient may have been bleeding from the stomach for some time before seeking advice, and, owing to the altered appearance of the vomited blood, may not have realized what was taking place. The classical term "coffee-grounds" or "hare-soup" vomiting can hardly be improved upon, and, once the patient is questioned on the point, he or she may at once recognize the accuracy of the description. This coffee-ground material results from the action of the hydrochloric acid of the gastric juice on the blood, the hæmoglobin of which becomes, in part at least, converted into hæmatin. This usually takes place most readily where the blood oozes slowly and in cases of gastric ulcer where the percentage of hydrochloric acid in the gastric juice is often above normal. It is most important, therefore, in every stomach case to inquire into the history of vomiting and the nature of the vomited material. The writer was consulted lately by a young woman who had several days previously brought up a breakfast-cupful of coffee-ground material and had so little notion of what it indicated that she took an actively effervescing seidlitz powder.

In the next place, we have to determine if it is blood that is vomited, and not bile, altered food, or something else. This is usually easily done when the blood is freshly effused, but when it

is changed there may be some difficulty in forming a positive opinion. The ordinary test with tincture of guaiac and ozonic ether cannot be relied on here, as the stomach may easily enough contain some article of food which will give the characteristic blue coloration as readily as blood does. If a more certain test be required, a particle of the suspected matter may be dried on a microscope slide, a crystal of sodium chloride and a little glacial acetic acid added, and the whole gently heated. Crystals of hæmin (hydrochloride of hæmatin) will then form, and can be readily recognized by their rhombic form and reddish-brown color; for their detection a high-power microscope is, of course, essential.

If doubt exist in the physician's mind as to whether it be a case of ulcer or cancer of the stomach in which the hemorrhage is occurring, it may be kept in view that hæmatemesis in cancer is usually scanty, irregular, and appears somewhat late in the clinical history, —that is, after the disordered digestion, loss of flesh, and general weakness have existed for some time.

Finally, in a case presenting marked pain, vomiting, and occasional bleeding, coming on at irregular intervals, with normal digestion between the attacks, it is quite possible that we are dealing with a locomotor ataxia, and the knee-jerks and the eyes should be investigated. An illustration of the possibility of making a mistake in this connection came under the writer's observation a year or two ago and made a lasting impression on his mind.

Intestinal hemorrhage manifests itself typically by melæna, or black motions; the fæces not only are dark in color (through the action of sulphides in the bowel on the iron in the blood), but also present a viscid or tarry consistency; they often have an extremely offensive odor. Melæna is met with in cirrhosis of the liver and chronic heart disease; in duodenal ulcer and the ulcers associated with enteric fever, dysentery, syphilis, and tubercular disease; in injury to the wall of the gut, as by a swallowed fish-bone, pin, or other pointed body, in cases where corrosive poisons have been swallowed; in certain constitutional diseases, such as scorbutus and purpura hæmorrhagica, and in some of the specific fevers, as yellow fever and hemorrhagic small-pox; where the *Anchylostoma duodenale* has invaded the intestine; and, lastly, where the patient is the victim of malignant disease of the bowel. In most of these cases the blood is altered, being thick and dark, but sometimes it is

of a dull red, and occasionally florid. Distinctly red blood is found in intestinal bleeding due to hemorrhoids, ulcer or fissure of the anus, cancer of the rectum and sigmoid flexure, and in other lesions of the large bowel. Not unfrequently the blood passed from the bowel has really come from a gastric hemorrhage, while in other cases it has been swallowed. Every practitioner should bear in mind that a patient taking preparations of iron, of bismuth, of lead, or of charcoal may present the phenomena of block motions; manganese if given as the oxide produces the same effect, since this preparation is black; if administered as a salt it does not darken the stools, as its sulphide is flesh-colored.

Treatment of Hæmatemesis.—The same general rules must be followed as in cases of bleeding from the lung, but feeding by the mouth should be stopped entirely and nutrition maintained by means of nutrient suppositories and enemata. How long this should be kept up will depend on circumstances, but after a free hemorrhage from a gastric ulcer no food should be taken into the stomach for six or seven days. Thirst is often greatly complained of, and for this small chips of ice may be allowed; but usually the patient wants too much, overloads the stomach with water, and so induces vomiting again. So it is better to cut off nearly all water for drinking, save a teaspoonful now and then, and to allay thirst by painting the tongue occasionally with glycerin and water (iced) and by bathing the hands and wrists frequently with cold water.

Of all drugs opium is the most valuable, a quarter of a grain of morphine may be given hypodermically or one grain of opium administered by the mouth, the dose being repeated in five or six hours. Indeed, rest, rectal alimentation, and opium will check most cases of hæmatemesis. Of these remedies, we may keep ergot in mind as being sometimes useful, and inject one-hundredth of a grain of citrate of ergotinine under the skin of the abdomen. Other drugs to be remembered are dilute sulphuric acid (from five to twenty drops); lead and opium pill (five grains); hazeline in drachm doses; and tannic acid (from two to five grains). Grünbaum has recently advocated a trial of suprarenal extract, based on Schäfer's discovery of the fact that it causes contraction of the muscle-fibres of vessel walls if applied directly and in dilute solution. It does not accelerate coagulation, nor does it form a clot, as

metallic salts and free acids do, but acts simply as a true vasoconstrictor. One or two tabloids (five grains) powdered and mixed with water, may be given by the mouth; it certainly appears worthy of further trial. In passive congestion and slow oozing alum and the astringent salts of iron may be found helpful. Where the bleeding is associated with a morbid condition of the blood, as in hæmophilia and purpura, a trial may be made of calcium chloride, as advocated by Wright, in order to shorten the coagulation time of the blood. He recommends that it should be given in full doses, say from fifteen to twenty grains three times a day, for three or four days, and then stopped. The bowels should be unloaded by a soap-and-water enema every other day till the hæmatemesis has ceased for a week, when a saline aperient may be given by the mouth.

Treatment of Intestinal Hemorrhage.—The general lines of treatment are the same, but the patient need not be prohibited from taking nourishment by the mouth. The best foods are those with a minimum of insoluble residue, such as well-strained chicken-broth or beef-tea, chicken-jelly or veal-jelly, Valentine's or Armour's extract of meat, and milk diluted with lime-water or the peptonized. Of drugs the most valuable are opium combined with acetate of lead; the liquid preparations of hamamelis; oil of turpentine in fifteen minim doses; tannic acid; or tannalbin (the albuminate of tannin), twenty grains every two hours; astringent iron salts; and bismuth subgallate, fifteen grains every four hours. A useful pill is one containing copper sulphate one-half grain, extract of opium one-fourth grain, and extract of hæmatoxylin three grains. Suprarenal extract may be tried here too. If the bleeding is from the rectum, injections or suppositories of hazelin should be used, or the bowel washed out with a weak solution of silver nitrite,—two grains to the ounce.

In all severe cases of internal hemorrhage the value of subcutaneous transfusion of sterilized saline solution (a teaspoonful to the pint) must be kept in mind; from fifteen to twenty ounces may be introduced into the loose cellular tissue of the breast by means of a hollow needle of fair size fitted with rubber tubing and a funnel.

Hæmaturia occurs in various maladies, medical and surgical, of which the chief are acute nephritis and renal infarct; tumors,

especially cancer and sarcoma of the urinary tract; calculus of the kidney or bladder; general diseases, such as scurvy, purpura, and malaria; chronic disorders of the heart, lungs, or liver; injury to any part of the urinary canal; parasitic infection by the *Distoma hæmatobium;* and also where some poisonous or irritating substance has been ingested, such as turpentine or cantharides. Of all these conditions the commonest (as far as the physician is concerned) is the bleeding of acute Bright's disease. The urine may assume any shade of color from a dull, smoky yellow to a deep red, and the guaiac reaction for blood is generally easily obtained. Chemical examination shows the presence of albumin and a diminution of the total urea, while under the microscope are seen the blood-cells as well as tube-casts (epithelial, blood, and granular).

Treatment.—In acute nephritis the kidneys should be left as quiet as possible, and not disturbed by the passage through them of diuretics or other drugs. But the loss of blood may be so considerable as to necessitate treatment, and the most useful drugs then will be the persalts of iron (perchloride and pernitrate) and alum. Potash or ammonium alum may be given in doses of from ten to fifteen grains three times daily. Another useful preparation is the double alum of iron and ammonium (ammonioferric alum), of which from five to ten grains may be administered, every four hours. It benefits both the hemorrhage and the anæmia. For chronic cases of hæmaturia Tirard recommends small doses of ergot. The gelatin treatment of internal bleeding and aneurism, so warmly espoused by the French clinicians, has also been used in bleeding from the kidney, a solution of gelatin in normal saline solution (sterilized) being introduced into the loose cellular tissue of the chest or (in some cases) given by the mouth. The solutions used by different physicians have varied in strength from two to thirty per cent. Of the stronger solutions one or two drachms and of the weaker ones from four to ten ounces may be introduced at a time. Schwabe reported a case of severe hæmaturia cured last year by this means after all others had failed. One ounce of a two per cent. solution was injected under each clavicle; this injection was repeated twenty-four hours later; the patient then took fifteen ounces of a ten per cent. solution each day for a week. The cure was permanent. This method of hæmostasis is not without danger. The chief risk is the production of thrombosis, embolism, and gan-

grene. Freudweiler has recently reported two cases where it was used in hemorrhagic nephritis, in one of which it increased both the blood and the albumin and caused hæmoglobinuria, while in the other death ensued from uræmia. He thinks that it is certainly contraindicated where the kidney is distinctly diseased. It appears to be a method worthy of trial, but should be employed with care and discretion.

With the question of cerebral hemorrhage we will not concern ourselves here, as it stands in a category by itself and is not amenable to the methods of treatment which we have had under consideration.

THE DIAGNOSIS AND PROGNOSIS OF SOME FORMS OF BLOOD DISEASE IN INFANCY.

BY J. S. FOWLER, M.D., F.R.C.P. (Edin.),

Extra Physician, Royal Hospital for Sick Children, Edinburgh.

As a primary morbid condition anæmia is probably of less importance in childhood than in adult life. No doubt the hæmatopoietic function of the child is readily disturbed by a great many disease processes, but when these are corrected, the blood, like all the other tissues of the infant, quickly asserts its recuperative power, and treatment directed specially against the anæmia is seldom needed. Nevertheless, one form of blood disorder is peculiar to infancy, and the blood at this period of life differs not inconsiderably from the adult type. In the following pages I propose to treat mainly of the question of diagnosis; if the treatment is dealt with scantly, it is because it resolves itself into that of the general malady rather than of the bloodlessness. I think also that if we conclude from a pale complexion and mucous membranes that a child is anæmic, we shall often be led into error, at least as to the severity of the anæmia. Frequent examinations of such cases have convinced me that a degree of pallor sufficient to indicate marked anæmia in the adult is in the child compatible with a very inconsiderable diminution of the corpuscles and hæmoglobin. The explanation has suggested itself that the relatively large body-surface, conducing as it does to loss of heat, may favor blanching of the skin by contraction of the superficial vessels. Be this as it may, I do not think it is possible to recognize slight grades of anæmia by inspection alone; in bad cases, of course, it is quite a different matter.

Excluding meanwhile from consideration leucocythæmia and pernicious anæmia, the anæmias of infancy have been classified in various ways. Monti proposes to divide them into mild and severe types, with and without leucocytosis; Luzet and others, into those with and those without splenic enlargement; while many simply

refer to them as rhachitic or syphilitic anæmia, etc. The second of these divisions seems for practical purposes the most satisfactory. In the first place splenic enlargement is so marked a feature that it gives a definite clinical character to the case, and in the second place it prevents undue stress being laid on any single blood change. Though the blood in splenic anæmia may vary within very wide limits, yet in many cases it is as a whole so characteristic that from the stained film alone one can hazard a diagnosis. On the other hand, in anæmia without splenic enlargement one rarely finds any considerable morphological alteration. But these points will be made clear later.

It is not necessary to refer in detail to the technique of blood examination. Briefly, the method which I have found most satisfactory for routine clinical work is the fixation of dried films in ten per cent. formalin in alcohol for from three to five minutes, followed by staining with Ehrlich's triacid mixture, or with eosin and methylene blue or hæmatoxylin. Benefit is gained by using both methods; by the former we get information about the granules, while by the latter the nuclear structure is better brought out.

Before passing to the pathological, we must shortly consider the blood of the healthy child. Our knowledge of this still leaves something to be desired, but, speaking generally, it may be said to differ from that of the adult in the presence of a larger number of leucocytes, and, after the first few weeks of life, of a lower percentage of red cells and hæmoglobin. The hæmoglobin percentage is highest at birth; it sinks gradually, and by the second or third month is about the same as in the adult. The fall continues until the second half of the first year, and the proportion then remains stationary until the fourth or fifth year, when it begins to rise. After the third month we may regard a figure of from 65 to 75 as lying within normal limits. The red corpuscles are abundant immediately after birth, numbering from five to six millions. Like the hæmoglobin, these diminish gradually, reaching a minimum about the second year. The leucocytes fall rapidly after birth, and by the end of a week are not more numerous than in the adult; they speedily increase, however, and during infancy and childhood from ten thousand to fifteen thousand is a fair average count. The red cells are more variable in size than at a later period, and a few normoblasts may be found immediately after birth, but they are by no means

numerous in mature children. The relative proportion of lymphocytes is high, amounting to fifty or sixty per cent., while the polymorphonuclear leucocytes are relatively fewer. Eosinophile cells vary greatly: they may be almost absent, or they may reach as much as seven per cent. of the total. To summarize the above: The blood in infancy, excluding from consideration the first few weeks of life, shows a gradual and progressive diminution of erythrocytes and hæmoglobin during the first year, a high leucocyte count, and relative lymphocytosis. It is not easy, indeed it would be misleading, to give absolutely precise figures; but I should regard the following as an average blood count in a child of six months or a year old: red cells from four to four and a half millions; leucocytes ten to twelve thousand; hæmoglobin sixty-five to seventy-five per cent.; the differential count being small lymphocytes from fifty to fifty-five per cent., larger mononuclear forms and cells with transitional nuclei two to six per cent., polymorphonuclears thirty-five to forty per cent., eosinophiles up to five or six per cent. Japha's[1] recent observations confirm the above statements. From an examination of the blood of twenty-two healthy children between six weeks and eleven months old, he finds that the average leucocyte count is thirteen thousand five hundred and sixty, the highest being nineteen thousand one hundred and twenty-five, and the lowest nine thousand six hundred. The average relative proportions of the various cells are as follows: small lymphocytes fifty-four per cent. (from thirty-five to seventy), large lymphocytes four per cent. (from none to eleven), polymorphonuclears forty-two per cent. (from twenty-five to sixty-one). The variations are considerable, but do not seem to bear any relation to the stage of the child's development.

Most of the difficulty attaching to an understanding of the anæmias of infancy arises in connection with so-called PSEUDO-LEUKÆMIC ANÆMIA. According to von Jaksch, the disease is characterized by (*a*) anæmia, (*b*) moderate leucocytosis, (*c*) enlargement of the liver and spleen. Luzet's description differs from that of von Jaksch in that he regards the presence of a large number of nucleated red corpuscles, many of which are undergoing mitosis, as an essential feature, and relegates to a secondary position the increased number of leucocytes. The question at issue is whether

[1] Jahrb. für Kinderheilk., February, 1900.

this should be regarded as a special form of anæmia. Before proceeding to describe the clinical picture, it will make matters clearer if I indicate my own view. Marked splenic enlargement is a not uncommon condition during the first and second years of life. Nearly all the cases that I have seen have been rickety,—in fact, in only one case of greatly enlarged spleen could that disease be excluded. Some of the patients were also syphilitic, but syphilis does not seem to be anything like so common a cause of the condition as rickets. Most of such patients are anæmic: when the anæmia is slight it presents no special features; when it is severe the blood invariably shows the changes I am about to describe. As a bad case improves (and improvement is the rule) the blood regains the normal appearance by degrees, and thus we may have a series of gradations from the normal or almost normal state to the very decided changes about to be detailed. In a former paper[1] the opinion was expressed that the condition was merely a secondary or symptomatic anæmia; I now feel inclined to modify it, and to look upon the disease as a special form of anæmia confined to young infants and dependent on splenic enlargement. I have examined many cases of anæmia without enlarged spleen, and have never found changes in the blood similar to those of pseudoleukæmic anæmia. Although there may be slight cases of the disease in which the blood changes are not distinctive, in bad cases they always are so, and, as has already been said, the examination of the blood alone admits of a probable diagnosis being arrived at. The condition, in fact, seems to have some analogies to chlorosis: it occurs only at a particular epoch of life, the clinical picture is quite distinctive, and in a marked case the blood changes are characteristic, while in slighter cases and in convalescence they pass insensibly to the normal condition. The most common antecedent to pseudoleukæmic anæmia seems to be rickets, but, as the disease affects only a small proportion of rickety children, some other as yet unknown factor must come into play. The diagnosis rests on the clinical picture as a whole, and on the exclusion of leucocythæmia. In dealing with the blood changes I hope to indicate in what way they give us help in the prognosis, and also to show that we cannot draw the same inferences from them as in the adult.

---

[1] Scottish Medical and Surgical Journal, May, 1898.

The clinical picture is very characteristic. The disease is most frequent between the tenth and eighteenth months, the earliest recorded case being in an infant of seven and a half months, the oldest a child of three and a half years. With this single exception all the patients have been under the age of two years; my own cases vary between ten and twenty-four months. Both sexes are equally liable. The onset of the disease is gradual, and the child is usually brought to the doctor because he is not thriving or is growing pale, or on account of rickets or some of its complications. The patients are pallid, and their mucous membranes more or less blanched; in bad cases (as in other forms of anæmia) the complexion has a faint waxy-yellow, greenish, or olive tinge, but there is really no coloration specially characteristic of splenic enlargement. Purpura is not common; I have twice (in fatal cases) seen a very slight petechial eruption over the abdomen, but never any internal hemorrhage or bleeding from mucous membranes. Nearly all the infants are rhachitic, sometimes extremely so; a greater or less degree of wasting is the rule, and occasionally the patients are very emaciated. On examining the abdomen the spleen is at once felt as a large, hard, painless swelling reaching well below the costal margin, and sometimes extending to the iliac fossa and nearly to the middle line. Slighter degrees of splenic enlargement are not attended by the distinctive blood changes. The liver is also larger than normal; its lower border may lie at the level of the umbilicus, but is usually about two finger-breadths below the costal margin. The glands are not enlarged, unless from some complication; there is no tenderness of the bones. A venous bruit in the neck is not uncommon, and sometimes there are functional cardiac murmurs; ascites and œdema have not been observed. Apart from these symptoms there is nothing specially characteristic; the children are usually apathetic and listless, diarrhœa and vomiting are common, there is often some bronchitis,—in fact, any of the ordinary complications of rickets may be present. The temperature is often raised, and, though in most cases some cause can be found to account for this, it occasionally seems to be due to the anæmia alone.

Blood.—In a fairly well-marked case the red corpuscles number from two and a half to three millions; the lowest count among my cases was one million five hundred and sixty thousand. Since the blood passes by insensible degrees to the normal, it is, of course, im-

possible to give an upper limit. The color index is always low, the average being .45, and the limit of variation .3 to .8. The latter figure was that of a very slight and convalescent case, and it must be borne in mind that the color index of the healthy child is low. The highest leucocyte count among my cases was forty-five thousand (though cases with from fifty to sixty thousand leucocytes have been recorded), but most commonly the number lay between eighteen thousand and thirty thousand. As a rule, the leucocyte count is roughly proportionate to the severity of the anæmia, but the relationship is not constant, as is illustrated by the following figures: four million red cells with twenty-one thousand eight hundred whites; two million three hundred and sixty-two thousand reds with fourteen thousand whites; two million eight hundred thousand reds with forty-five thousand whites. Still, with even a comparatively slight fall in the red corpuscles there is generally more or less leucocytosis.

Red Corpuscles.—Even in extreme anæmia poikilocytosis is not well marked, but there is usually a great deal of variation in the sizes of the cells. Some of the larger ones commonly show polychromatophilia. The most striking change is, however, the presence of large numbers of nucleated red corpuscles. These bear a general, but by no means constant, relation to the degree of anæmia. Thus, in two patients aged ten months I found three million one hundred thousand red corpuscles with two thousand four hundred and forty erythroblasts, and two million three hundred and forty-four thousand with two hundred and eighty, respectively. In another—a girl aged two, whose blood was in other respects practically normal —there were over one thousand erythroblasts per cubic millimetre. These cells also have other features of interest; we may find that all are normoblasts, or that a considerable number, sometimes up to a quarter, are megaloblasts. The nuclei of both forms are often irregular, and may be double, trefoil, or branching. Mitotic figures are fairly common. I have not been able to trace any connection between the severity of the anæmia or the development of the patient and the number of megaloblasts present.

Leucocytes.—When a specimen from a well-marked case is examined, one is at once struck by the polymorphous character of the leucocytosis, which differs entirely from that seen in any other condition. There is a much larger number of cells with transitional

nuclei than normal. Large and small lymphocytes are sometimes present in almost equal abundance; at times the former, at times the latter preponderate. Eosinophile cells may be entirely absent; on the other hand, I have found as many as seven per cent. Myelocytes may be found in almost every case in which there is a decided leucocytosis; they do not, as a rule, form more than one to three per cent., but may rise to five or six per cent. of the total. On account of the numerous transitional forms present, it is often difficult to decide which cells are to be called myelocytes, since many of the former, with their large, pale nuclei, contain neutrophile granules, and differ only from myelocytes in the presence of a slight notch or indentation of the nucleus. Again, some of the small lymphocytes may have a neutrophile granulation—small myelocytes of Cabot. Among the larger lymphocytes a good many have granules staining with basic dyes, and some take on both basic and acid dyes. Eosinophilia may or may not occur; these cells vary very greatly in number, not only in different cases, but at different times in the same case. Sometimes one notices that all the polymorphonuclear cells have a somewhat coarser and more intensely staining granulation than normal, giving an appearance resembling eosinophilia. Eosinophile myelocytes are decidedly rare. The average differential count in my cases is: Lymphocytes fifty per cent. (from thirty-four to seventy-six), transitional twelve per cent. (one to twenty-four), polymorphonuclear thirty-six per cent. (twenty to forty-three), eosinophiles one and a half per cent. (from none to seven). From this it appears that the transitional forms are increased, and this is especially marked in bad cases, in which something over twenty per cent. is the rule. This is indeed the most constant change in the leucocytes, and the increase is mainly at the expense of the polymorphonuclear cells, and as the case improves one usually finds that the latter rise to the normal, while the former, younger forms diminish. A high percentage of transitional cells is generally associated with a high percentage of the larger lymphocytes, but it is so difficult to distinguish these from the smaller lymphocytes that differential counts are unreliable as giving information in this respect.

To summarize the above: (1) Erythrocytes are affected rather in size than in form, the hæmoglobin content being diminished, especially in bad cases. Both normoblasts and megaloblasts occur

in large numbers,—up to two thousand five hundred per cubic millimetre; some have irregular or mitotic nuclei. These may occur even when the anæmia is comparatively slight; possibly this may be explained on the ground of their persistence during the latter part of convalescence. (2) The feature of the leucocytosis is its polymorphous character, due to the presence of intermediate forms. We find an increase in the cells with transitional nuclei, and many which stand midway in appearance between lymphocytes and myelocytes, myelocytes and polymorphonuclears, and neutrophiles and eosinophiles. These variations occur not only in the different cases, but also at different stages of the same case. (3) The number of red cells may sink to a million and a half or less; the color index is always low. The leucocytes may amount to fifty or sixty thousand, and their number bears a general but not constant ratio to the grade of the anæmia. (4) Between well-marked cases and a normal or almost normal appearance, a whole series of intermediate stages may be found.

Diagnosis.—In the majority of cases no difficulty arises. The clinical features, with signs of simple anæmia or anæmia with leucocytosis, and especially the presence of erythroblasts, are sufficiently distinctive. Occasionally the possibility of leucocythæmia has to be thought of, but this will be referred to later.

Prognosis.—The majority of the cases which I have seen have gradually improved under treatment and have passed from under observation. I cannot, therefore, speak with certainty as to the duration of the condition. A spleen filling half of the abdomen may become imperceptible in a year or less, and the anæmia is often recovered from before the splenic tumor subsides. In the fatal cases which I have seen pneumonia has been the immediate cause of death. The following are the facts on which I think a prognosis can be based: (1) The general condition of the patient, especially the severity of the rickets, together with the presence or absence of complications, is perhaps the most important guide. (2) A great diminution of the red cells, and in particular of their color index, is a much more unfavorable sign than any qualitative alteration in the corpuscles. (3) A high leucocyte count is unfavorable, especially when there is a large percentage of transitional forms. (4) The occurrence of petechial hemorrhages is of bad omen. (5) A progressive increase in the polymorphonuclears, with a diminution

in transitional cells, shows that the case is doing well. (6) No prognostic importance can be attached to the number or form of the erythroblasts, to the percentage of lymphocytes, or to the presence of a few myelocytes. (7) The gravity of the condition is not influenced by the size of the spleen.

Morbid Anatomy.—The following changes were found in a fatal case.[1] The Malpighian bodies of the spleen were not distinct. The sinuses are more evident than normal, owing to an increase of the young connective tissue of the pulp; the connective tissue is in places unusually diffuse. The endothelium lining the walls of the sinuses is not much altered, but here and there it is a little more prominent than usual, and a few of the cells are markedly bulging. Numerous clusters of deeply stained, minute, rounded, pear-shaped, or irregular bodies are seen in the pulp; these are possibly fragmenting nuclei. The changes in the pulp correspond with those seen in chronic venous congestion plus the presence of leucocytotic blood in the sinuses. The glands show an increase of the leucocytes in the sinuses. Apart from the leucocytosis the liver shows no marked change. None of the hæmatopoietic cells figured by Luzet are present.

Treatment.—The main point to be emphasized is the importance of treating the constitutional condition,—in most cases rickets. Still, benefit has seemed to result from adding arsenic to the usual antirhachitic remedies. Iron does not seem to be of much use in these cases.

LEUCOCYTHÆMIA.—Most cases of this disease occurring in infancy are of the lymphatic type, and the diagnosis of these really presents no difficulty. I have not had a case under two years, but in a very typical acute lymphæmia in a boy of four the leucocytes reached the enormous total of nine hundred thousand per cubic millimetre (the average, according to Cabot, is about one hundred thousand), the red cells being two million five hundred thousand and the hæmoglobin twenty-five per cent. The increase in the white cells was almost exclusively due to small lymphocytes, which made up ninety-nine per cent. of the total, cells with neutrophile granules were present to the extent of one per cent. only, while no eosino-

[1] For this pathological report I am indebted to Dr. Shennan, pathologist to the Sick Children's Hospital, who very kindly examined the specimens for me.

philes could be found. Two special features of interest, dependent on the youth of the patient, were noticed. First, nucleated red cells (which are infrequent in this type of leukæmia) were abundant; they were all normoblasts, but with dividing or fragmenting nuclei in many cases. Secondly, relatively few though the granular leucocytes were, they showed an unusual number of transitional forms and a fair proportion of myelocytes.

The difficulty of diagnosing *spleno-medullary leucocythæmia* during the first two years of life is sometimes extreme. In the first place the disease is excessively rare; Cabot, indeed, states that Morse's is the only case in which the diagnosis is made reasonably certain by a color analysis. The following note of a case in which there was considerable doubt will illustrate the question. The patient was a girl aged thirteen months, who had been ill for three months. There were slight signs of rickets, the spleen filled half the abdomen, the liver was enlarged, and some of the glands were unduly distinct. The skin bruised very readily, ordinary percussion producing ecchymosis; during the six weeks the patient was under observation purpura and epistaxis occurred. The illness terminated in a fatal bronchopneumonia. Repeated examinations of the blood gave counts of the red corpuscles from two million nine hundred and fifty thousand to three million nine hundred and fifty thousand, while the leucocytes varied between twenty-three thousand four hundred and fifty-eight thousand. The differential counts also varied a good deal; for example,

Lymphocytes	37	39	46	36
Polymorphonuclear	48	50	45	58
Myelocytes	14	11	7	4
Eosinophiles	1	. .	1	2
Erythroblasts, per cubic millimetre	4800	7000	3000	4150

The nucleated red corpuscles were nearly all normoblasts; in some the outline of the nucleus was irregular, in others mitotic figures were present. The polymorphonuclear leucocytes could be roughly divided into large and small, the latter being like those normally found, while the former had larger and less convoluted nuclei and rather sparse granules. Between these cells and those with transitional nuclei, and again between these last and myelocytes, many intermediate forms were present. Towards the end of the case the blood assumed a much more normal appearance, the leucocytosis

diminishing, fewer of the large cells being present, while the hyaline forms became more numerous.

Dr. Shennan reported that the post-mortem appearances were those of leucocythæmia.

This case corresponds fairly closely with those given as doubtful by Cabot. My reasons for regarding it as leucocythæmia are: (1) The general features of the case,—the obviously serious condition of the patient, the slightness of the rickets, and the occurrence of hemorrhages without any great diminution in the red corpuscles. (2) The high leucocyte count, which, though low for leucocythæmia, was high for the ordinary splenic anæmia of infancy, especially when associated with a comparatively slight diminution in the red cells. (3) The high percentage of myelocytes,—from eleven to fourteen per cent. on some occasions. (4) The great number of nucleated red corpuscles, and the fact that practically no megaloblasts were found, as well as the relative infrequency of atypical nuclei. (5) The small number of lymphocytes. (6) The anatomical changes. Though no one of these points would by itself be conclusive, taken together they are strongly in favor of the case being one of true leucocythæmia. It has suggested itself as a possibility that, after all, this may be the form which spleno-medullary leukæmia assumes in infancy. It is at least certain that no cases in which the blood has approximated to the adult type, either in the degree of the leucocytosis or in the number of myelocytes, have been recorded.

Pernicious Anæmia.—I have no personal experience of the disease in infancy, but from what has been said it will be seen that the diagnosis would be a matter of some uncertainty, and, indeed, few of the cases recorded within the first two years seem conclusive. The following case will illustrate the kind of difficulty one has. A boy aged three years and four months, with marked signs of rickets and extreme anæmia, was under observation for three months, and now, five months later, remains in fair health. The spleen was slightly enlarged, the complexion was pale, but without the characteristic waxy lemon tint, and no hemorrhages ever took place. Between the middle of July and the middle of September the red cells slowly increased from nine hundred thousand to two million five hundred thousand, at which level they remained stationary. The color index was never below 1,—usually 1.1. The leucocytes re-

mained at about eight thousand. The differential count was fairly constant, the average being lymphocytes forty-five per cent., polymorphonuclears forty-nine per cent., eosinophiles three and seven-tenths per cent., and myelocytes seven-tenths per cent. The nucleated reds ran between one hundred and sixty and four hundred and twenty per cubic millimetre, about one-fourth being megaloblasts. On the whole, I think that this is probably a case of pernicious anæmia. Such a blood condition in an adult would be conclusive; we have the extreme anæmia, the high color index, the presence of megaloblasts, and the leucopenia with a few myelocytes and relative lymphocytosis. In the child, as we have seen, no great stress can be laid on the presence of megaloblasts or a few myelocytes, and the percentage of lymphocytes is not abnormal, so that these points are of no diagnostic value; but the leucopenia and in particular the high color index are not common even in the worst anæmias of childhood, so that perhaps they argue more strongly in favor of pernicious anæmia than they do when they occur in the adult.

Neurology

SOME SUGGESTIONS AS TO THE MECHANISM OF MENTAL OPERATIONS.

A LESSON IN THE COURSE ON THE HISTOLOGY OF THE NERVOUS SYSTEM, DELIVERED IN THE MEDICAL SCHOOL OF THE UNIVERSITY OF MADRID.

BY PROFESSOR SANTIAGO RAMON Y CAJAL,
Professor of Anatomy and Histology at the Royal University of Madrid, Spain.

GENTLEMEN,—The series of lessons which I have had the honor to give you have been occupied with the subject of the new ideas in the histology of the nervous centres that have engaged the attention of so many well-known histologists during the last ten years. Undoubtedly the most important discovery has been the fact that each one of the cells of the central nervous system is absolutely independent of every other and exists free and unconnected in the midst of the cell groups. The germ of this discovery comes from Golgi's observations. He demonstrated two very important truths,—first, that every nerve-cell has a cylinder-axis as well as protoplasmic expansions and that these give off a number of fine collateral branches; second, that the protoplasmic prolongations of the cell do not form a net-work, but terminate by free endings.

With regard to the connection of nerve-cells and fibres, Golgi, under the influence of Gerlach's reticular theory, considered that, instead of a protoplasmic net-work, there was a reticulum formed by the collateral branches and terminal nerve-fibres or cylinder-axes. Golgi was not able to break entirely with tradition. Some fifteen years ago certain histologists declared it to be possible that nerve-fibres and cylinder-axes terminate as freely as do the protoplasmic extensions. His and Forel maintained this doctrine, but neither of them could definitely decide the question, since they were not able

to demonstrate the terminal arborizations of the cylinder-axes and the indirect communications which are established around nerve-cells.

It is the existence of these terminal endings that we have been able to demonstrate, so far as regards the medulla, the olfactory bulb, the retina, the optic centres, the sympathetic system, and so forth. Our demonstrations have been confirmed very fully by Koelliker, His, Lenhossek, Van Gehuchten, Retzius, and here in Spain by my brother and Claudio Sala. In order to show you of how much assistance this theory may be in the explanation of many mental processes which have been hitherto very difficult to understand, I shall discuss some of the hypotheses of physiological psychology which have been advanced on the foundation of the new theory—the neuron theory, as it is called—of the constitution of the central nervous system.

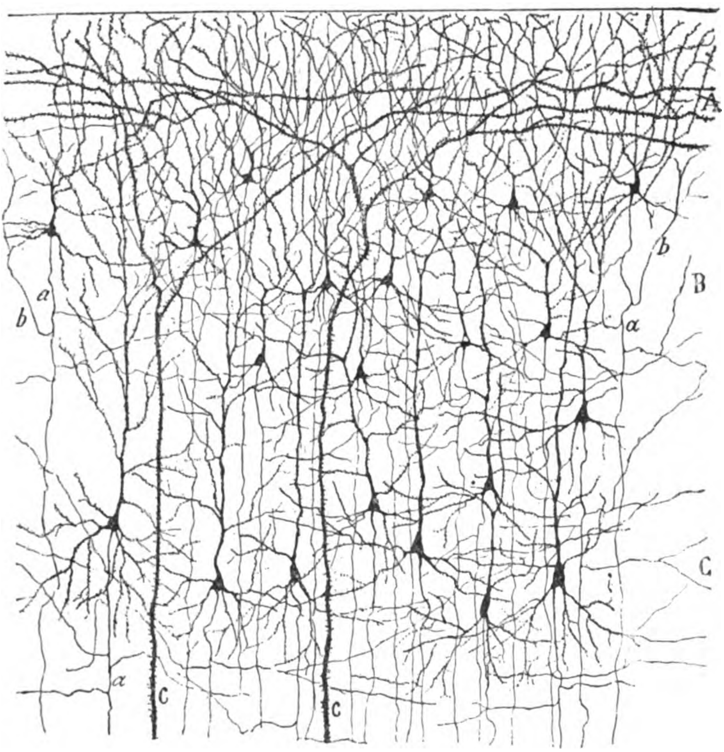
THE NERVOUS MECHANISM OF PERCEPTION AND ATTENTION.

In recent years, then, our ideas of the structure of the nervous system have been completely changed. We now know that there lies between the sense organ at the periphery of the nervous system and the nervous centre not a continuous fibre, but a series of cellular elements. A well-connected chain of conducting cells, or neurons, is made up by these elements. Impressions are made upon a single cell at the periphery. As the result of the disturbance in the single cell, an ever-increasing number of cells are affected, as the nervous impulse travels towards the nervous centre. On the connection of these cells in the nervous centres depends the accomplishment of the complex nervous reflexes that result from a single sense impression.

This law, that the disturbance of a single cell of the periphery arouses many cells to activity in the nervous centres, can be illustrated by various examples. When a ray of light touches one of the cones in the fovea centralis retinæ, in which, as is well known, acuity of vision is greatest, the nervous impulse is carried from the cone to a bipolar cell. This cell conducts the impulse to a ganglion-cell lying in the ganglionic cell layer of the retina beneath the rods and cones. The principal nerve-fibre from this cell runs into the region of the corpora quadrigemina, where it divides into a large number of branches. By means of these branches the original simple nervous light impulse is distributed to a large group of cells

lying in this part of the brain. Now, the axis-cylinder of this group of cells terminates in the occipital convolutions of the occipital lobes of the brain. In this region the terminal nerve-endings of the corpora-quadrigeminal cells come in contact with the branches of a multitude of pyramidal cells. It follows, therefore, that the simple original light impression derived from the disturbance of a single

FIG. 1.



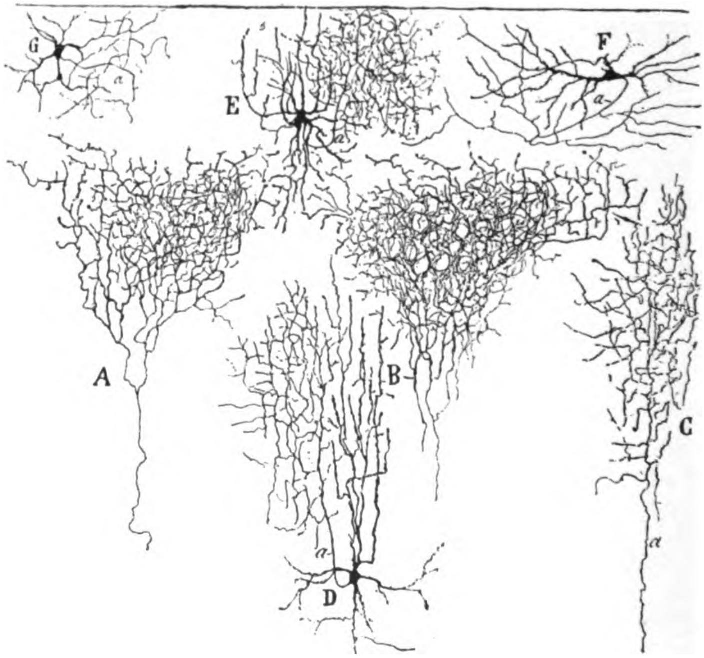
Small and medium-sized pyramidal cells of the visual cortex of a child twenty days old. Section taken from the neighborhood of the calcarine fissure. A, plexiform layer; B, layer of the little pyramid; C, layer of the medium-sized pyramid; *a*, descending axis-cylinders; *b*, ascending or centripetal collaterals; *c*, stems of the giant pyramidal cells.

retinal cone is multiplied into hundreds or thousands of nerve-cell disturbances by the time it reaches the cortical centre for sight. This example was, of course, given by Golgi before we knew definitely of the existence of neurons. It has been fully confirmed by recent investigations.

Practically the same process takes place in the hearing apparatus

and in the recognition of sound. One or two of the hair-like cells of the organ of Corti are disturbed by a wave of sound. They transmit the impulse to an acoustic nerve-fibre belonging to one of the cells of the spiral ganglion of the cochlea. The nervous prolongations from these cells run to the ventral acoustic nucleus in the medulla oblongata. From here each acoustic root-fibre, by

FIG. 2.

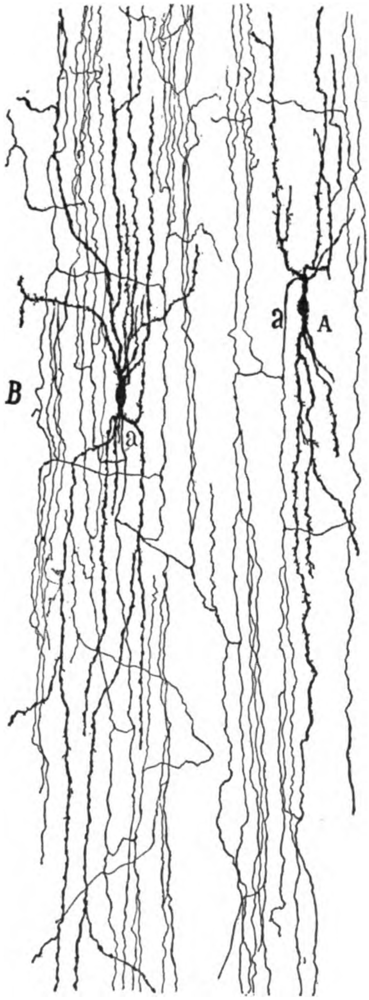


Series of sections showing the finer nerve-endings and branchings of the first and second layer of the visual cortex of a child fifteen days old. A and B, very thick nerve plexus of the layer in which the little pyramids are contained; C, a plexus containing a series of branches that is less thick and intricate; D, small cells whose ascending axis-cylinders have resolved themselves into a set of similar branches; E, arachnoid star-cells whose axis-cylinders produce a thick plexus in the first layer; F and G, small cells with short axis-cylinders that have very few branches.

means of a bifurcation and a series of abundant collateral branchings, communicates its impulses to a large number of cells. Every one of the conducting fibres or axis-cylinders of the ventral nucleus runs to the corpus trapezoides of the bulb, where, by means of a special large series of collateral branches, a new group of neurons, which are situate here and in the upper part of the olivary body and some of them in the pre-olivary nucleus, are made to become

part of the conducting chain of cells. Finally, the nervous impulses reach the brain and are spread over a considerable group of pyramidal cells in the cortex.

FIG. 3.

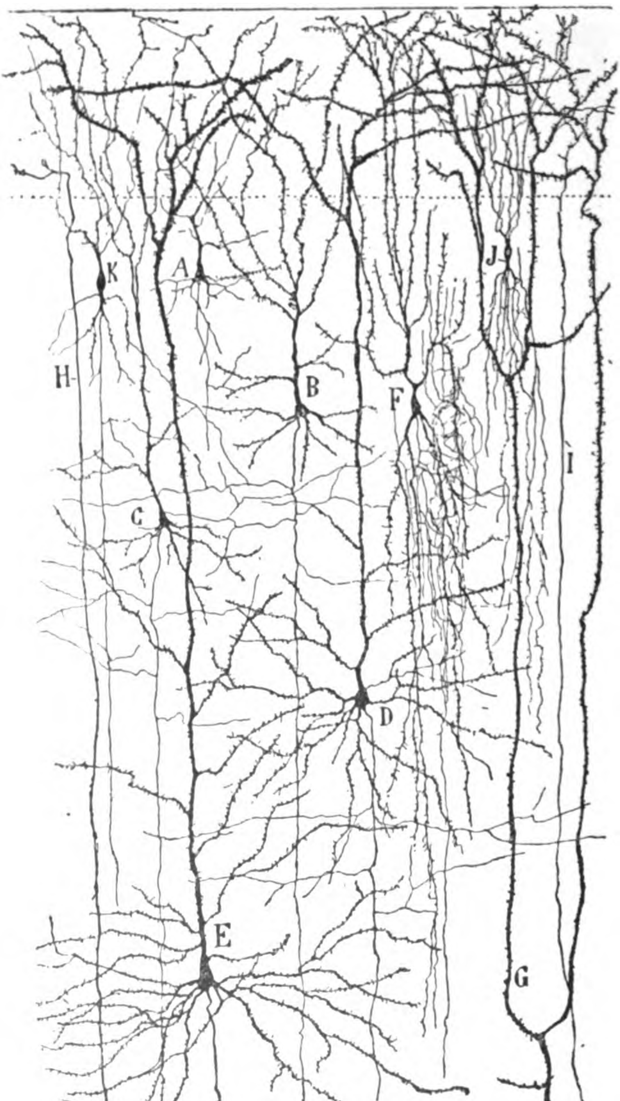


Small cells from various layers of the auditory cortex of a child twenty-six days old. A, cells with descending, rather frequently branched, axis-cylinders; B, cells whose axis-cylinder becomes fibrillated, giving off numerous bundles of ascending and descending branches; a, axis-cylinder.

The same almost avalanche-like multiplication of impulses as the result of a single cell impression can be traced in the apparatus of smell and also for the terminal touch-endings in the skin. All

histologists who during recent times have studied the structure of the olfactory bulb and of the spinal cord are convinced of this.

Fig. 4.



First, second, and third layer of the anterior central convolution (that is, of the ascending frontal convolution) of the brain of a child one month old. A, B, and C, little pyramids; D and E, medium-sized pyramids; F, cells with two sets of tufts; their axis-cylinders resolved themselves into end tufts; G, protoplasmic layer that comes from one of the large pyramids of the fourth layer; H and I, fine dendrites of the cells of the sixth and seventh layer; J, small cells with two end tufts; K, spindle cells with long axis-cylinder.

Golgi, von Lenhossek, Van Gehuchten, Koelliker, and Retzius have confirmed this theory, which is now one of the accepted doctrines in brain anatomy and physiology.

From what we have said, it follows that, while the number of sensory cells originally disturbed may be very small, the conducted impulses when they reach the brain arouse into activity a large number of pyramidal cells in the cortex. We have the right to conclude, then, that any single perception is not the result of the activity of a single cell, but of many. The simplicity of our perceptions is only apparent and our ideas in this matter are false, because we have not realized how complicated is the mechanism that serves to convey sensations to the higher centres.

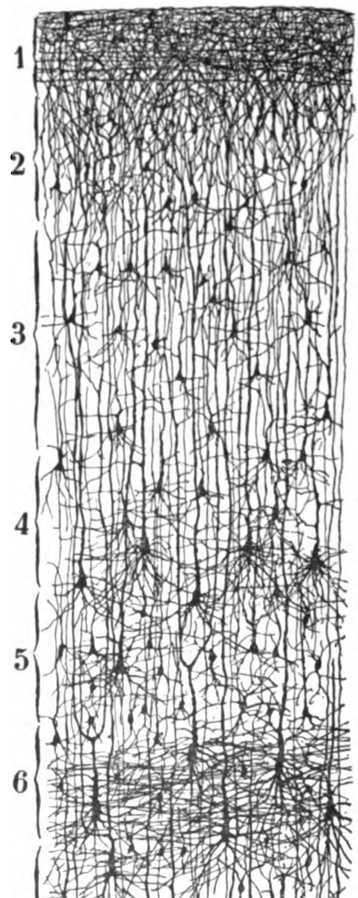
THEORIES AS TO THE HISTOLOGICAL MECHANISM OF THE ASSOCIATION OF IDEAS AND OF THE SLEEPING AND WAKING CONDITIONS.

Sensory impulses, their conduction to the brain, their action upon certain definite groups of cells therein, are phenomena which are entirely beyond the domination of our will. We can neither suppress nor modify sensations nor the cerebral activity which they arouse. Just as soon as our eyes open and see things, the image of the objects perceived is registered in our brain. We may turn our attention from such objects. We may refuse to look upon the pictures which they present; these things are in our power, but the suppression of perception is not in our power. Once the anatomical and physiological conditions of sensory activity are fulfilled, we cannot hinder the whole series of neurons which lie between the terminal nerve-endings and a group of cerebral cells from being aroused into activity and conducting the impulse from the periphery to the centre. Of course, this constancy of the mechanism of stimulation, conduction, and perception depends upon the completeness of the chain of optical, acoustic, or other sensory neurons and presupposes a healthy organism.

The effect of the will comes into play just as soon as the sensation is registered in the brain and we begin to reflect about it. The secondary perception which we know as reflection depends to a great extent upon our will. The nervous stimulation which reaches the cerebral cortex produces in different cases very different effects. Even when sensations are alike in intensity and quality, the effect

they produce does not always follow the same course. At times the energy of the inflowing stream of sensory impulses is, as Forel says,

Fig. 5.

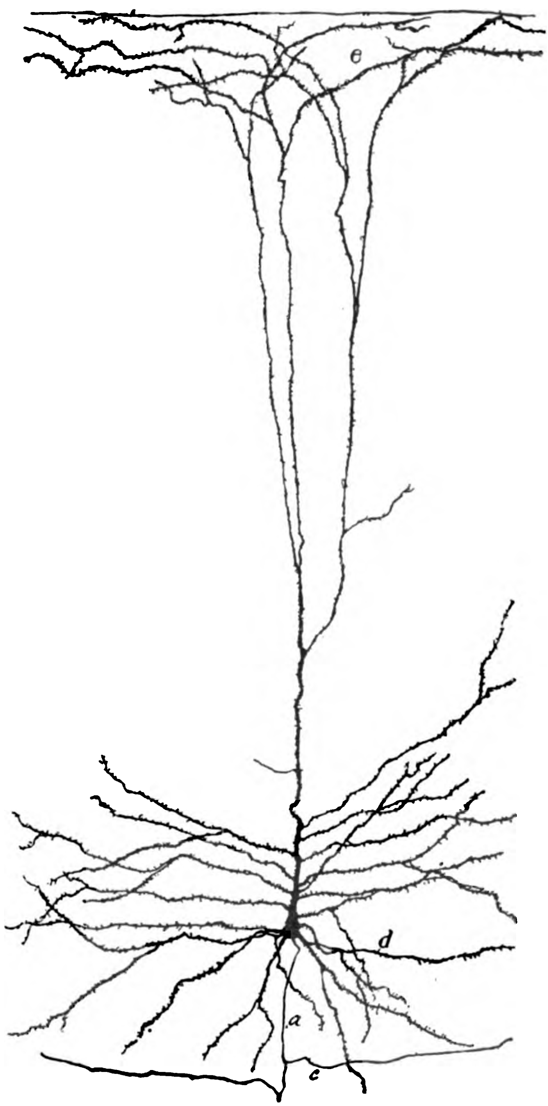


Layers of the posterior central or ascending parietal convolution of a new-born child. 1, plexiform layer; 2, small pyramids; 3, medium-sized pyramids; 4, external large pyramids; 5, small pyramids and star-shaped cells; 6, deep layer of large pyramids; 7, spindle- and triangular-shaped cells.

absorbed by the brain. It is translated into ideas, judgments, resolutions. In certain cases, however, it results in the production of

motor reaction. The process of association does not always follow

FIG. 6.



Deep layer of giant pyramidal cells of the posterior central or ascending parietal convolution of a child thirty days old. *a*, axis-cylinders; *c*, collateral branch; *d*, long basilar dendrites; *e*, end tuft.

the same direction. At one time an idea awakes an analogous idea; at another, a similar idea; sometimes it suggests a contrast. Even

under successive stimulations of the same kind, the train of ideas awakened is not always the same. Experience has shown that under certain conditions speech becomes difficult, memory leaves us in the lurch, and the endeavor to make associated ideas proceed in a certain direction becomes almost impossible. At times it happens that an idea which has been looked for with considerable effort suddenly flashes on one, just as if the continuity of an interrupted current had been suddenly restored, or as if the obstacle which prevented contact between nerve-ending and cell-bodies had been suddenly removed.

All this seems to show that the structure of the sensory centres in the brain and that of the association tracts is not always absolutely identical in details, but that perhaps a variable histological factor exists, differing in different individuals and so giving rise to the limitless variety that exists in the psychical processes of different persons. It is evident that the material basis of intellectual processes largely modifies the rapidity and even the perfection with which these processes are completed. Pathological conditions of various kinds so modify mental activity as to make it quite different under differing circumstances. It is also probable, however, that men differ very much in the number and form of the cellular elements in their brains, and that this accounts for intellectual differences.

I do not fail to recognize that the variations in intellectual processes are to a certain degree due to inhibitory influences, to lack of intensity in nervous impulses, to increased resistance in the conduction of impulses as a result of varying conditions in the nutrition of nerve-fibres and of the substance lying between the nerve-fibres. There is no doubt, too, that merely physico-chemical disturbances, without either anatomical or histological differences, may produce very differing degrees of activity in the nervous elements. These, however, do not seem to account for all the variations in psychical manifestations which we know to occur. We must assume, though it is yet only a theory, that men differ very materially in the histological structure of their central nervous system.

A very interesting hypothesis as to the underlying cause of sleep and of the artificial rest of the brain produced by narcotics has been presented by Duval. The French histologist took as the basis of his theory my discovery that the terminal branches of the nerve-cells

are absolutely free; they are not attached to any other nervous element; they are in contact with the bodies and the protoplasmic processes of the nerve-cells, but no more. Duval assumes that the connections in the nervous system and the disconnections are made by means of amœboid movements of the terminal nerve-endings. During natural or artificial sleep the nerve-endings retract, and so cells are separated from one another and the conducting apparatus is interrupted. During the wakeful state the terminal nerve-endings once more come in contact with other cell-bodies and their branches, and the current of nervous impulses passes without difficulty from the fibres of one nerve-cell to those of another.

There are, however, a number of difficulties in this hypothesis, most of which have been pointed out by Koelliker. As a matter of fact no one has ever been able to recognize the slightest amœboid movement on the part of nerve-fibres and terminal nerve-branches, which can be well observed during life in the larvæ of salamanders. Whether or not there may be movement in the neurons of animals lower in the scale remains to be seen; some observations seem to show that perhaps there is.

Against the hypothesis that Duval has advanced we have ourselves the following objection. First, the terminal nerve-endings in the cerebellum, in the olfactory bulb, and in the central acoustic ganglion always present the same extension, the same form, and the same interval from the body of the cell, no matter what the form of death undergone by the animal may have been. If cell contraction had anything to do with the unconsciousness that precedes death, one would expect cell distances to be very different after the various kinds of death. The nervous system, for instance, gives very different symptoms in chloroform poisoning, in death from curare or from strychnine, and in fatal hemorrhage. The appearance of the nervous system of animals dead from these various causes is, at least as far as regards the distance that exists between terminal endings, always the same.

THEORY AS TO MEMORY.

Memory constitutes one of the most interesting faculties of the human intellect and one that is evidently dependent to a very large extent on some intricate physical mechanism. The neuron theory enables us to understand it and to explain its mechanism better than

anything else. Every repetition of a sensory impression—for instance, of hearing or sight—produces a period of activity in the same group of pyramidal cells. If we recall for a moment what is necessary for the act of reading, or writing, or painting, we will remember that almost instinctively we perform the act under like conditions, though the circumstances may be different. We bring the book or paper or canvas to the same distance from the eye, because this enables us to use just the same series of cells each time that we perform the act.

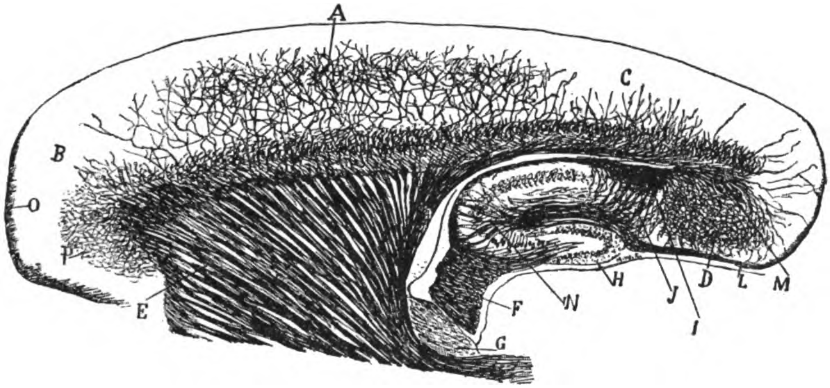
This consideration will make us understand better, too, why the repetition of some idea under corresponding conditions produces such an enduring and exact remembrance of it. The same group of cells produce the same series of movements each time that the act is performed. They obtain the habit of forming certain associations. Even when a picture is not present then it is easy to have them recall and rehearse the acts which they performed before and so obtain a mental picture. This makes clear why we do not remember exactly and sometimes do not remember at all an object that we have seen but once. The combination of cells necessary for its reproduction is not readily remade for lack of habituation.

Of course it is impossible for us in our analysis of the mechanism of cerebration to explain everything. How we are able to reproduce scenes at a time when their actual perception is impossible we cannot understand. We are also in the dark with regard to the histological process of association. We know that the so-called associations of time and place, of analogy and contrast, which, according to Wundt's laws, exist for every idea, are somehow made possible by the establishment of connections between collateral nerve-branches and protoplasmic processes of cells which lie in the same nerve-centres. It seems probable that Martinotti's cells, with the ascending axis-cylinders and the many-pole cells of the first layer of the cortex, play an important *rôle* in these processes. It is well known, however, that a sensation of taste may call up a visual picture, while a sound may lead to an idea of form or color. It is evident, then, that some important means of connection exists between the centres for the different senses. These are variously developed in different people, and constitute the basis of what we call taste in the various arts. There are certain so-called association-cells in the cerebral hemispheres which seem to act as conductors for these

communications from sense to sense. By their means a single primary conception seems to be able to run through the whole complicated register of memory for sensations of various kinds.

The nerve-endings of the retina and of the optic lobe in reptiles and frogs present the same appearance, no matter whether the animal has been killed after these parts have been for a long time at rest, as when it has been kept for some time in the dark before death, or when the optic nerves have been exercised very strenuously, as when the animal was kept for several hours in strong sunlight just before death. These experiments we have performed very carefully, with the hope that some difference might be found in the pict-

FIG. 7.



Section of the brain of a mouse a few days old; direction of the section somewhat sidewise. A, sensory branches of the motor sphere; B, frontal pole of the brain free from sensory fibres; C, posterior portion of the cortex, whose centripetal fibres mature later; D, plexus of the optic fibres; E, the corpus striatum; F, fimbria; H, fascia dentata; I, thick bundle of fibres which gives off a series of branches that terminate in the plexiform layer of the cornu Ammonis; J, the cornu Ammonis; L, plexiform layer of the inner surface of the hemispheres, covered with a horizontal layer of nerve-fibres; M, bundle of optic fibres; N, ascending fibres of the layer of large pyramidal cells of the cornu Ammonis.

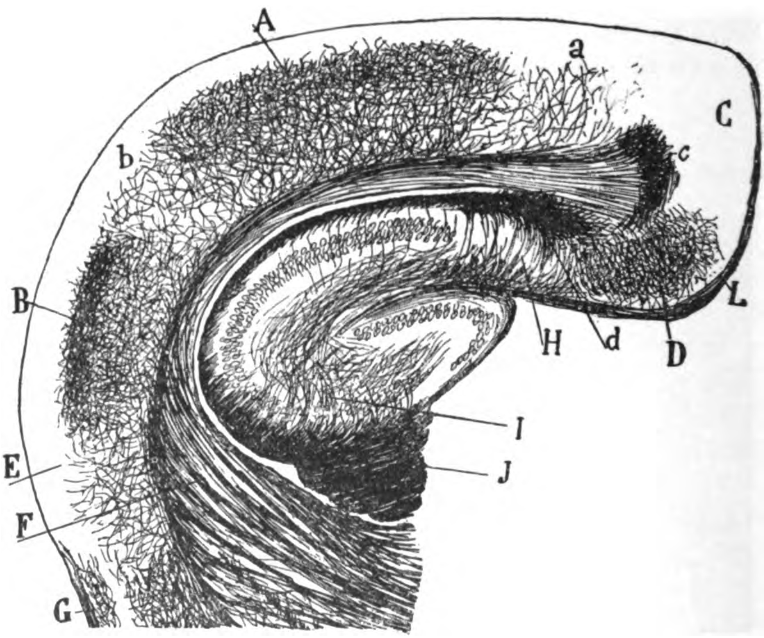
ure presented by the nervous system under these conditions; but we have been able to find absolutely nothing.

On the other hand, we have come to the conclusion, as the result of studies in the cerebral cortex, that during intellectual work the forms of the neuroglia-cells vary very much as the result of mental effort. The neuroglia-cells are the interstitial elements which lie between nerve-cells and seem to act as insulators. In the gray matter of different parts of the same brain the neuroglia-cells are found in some cases retracted, with short and thick processes, in other places with long, numerous secondary and even tertiary branches.

Between these two conditions of retraction and almost complete relaxation there are all forms of intermediate states. These various phases of the neuroglia-cells in the gray matter have undoubtedly been seen by other observers, but have heretofore been taken to mean fixed cell forms,—that is, simple morphological varieties of Deiters's cells.

The more we consider the significance of the neuroglia-cells the

FIG. 8.



Transverse section of the brain of a kitten a few days old; the section runs a little behind the corpus callosum. A, sensory plexus of the motor region; B, acoustic nerve plexus; C, inner surface of the hemispheres free from sensory nerves; D, very probably the optic plexus; E, nerve zone without sensory plexus; F, corpus striatum; G, olfactory tract.

more we become persuaded that observers, under the influence of the views held at a time when the true structure of neuroglia was misunderstood, have grouped together, under the single term neuroglia, a series of elements that have very various physiological values. In my opinion, the neuroglia of the white brain matter is quite different from that contained in the gray matter. The hypothesis that the neuroglia-cells described by Deiters are meant only for the nutrition or the support of other cells and nerve-fibres must be re-

garded as based on immature conclusions. It is not easy to understand what nutritive advantage the nerve-cells could derive from the plasma finding its way to them through a net-work of neuroglia-cells which absorb a certain amount of the nutritive material. There seems no good reason why the plasma could not easier find its way through the amorphous, somewhat fluid substance which serves as a connective tissue for the ganglion-cells. Without doubt this is the way that the nutritive juices reach the cells in the gray brain material, for in the gray layer neuroglia-cells are rare and occur only where nerve-cells are comparatively infrequent. That the neuroglia-cells form a support for the nerve-cells seems an unsubstantiated theory. The reason therefore is trivial and their presence would be futile. What purpose as supporting material would these small, isolated, pliable, delicate cells furnish, since they are much smaller and less robust than the nerve-cells themselves? Besides, many ganglion-cells are absolutely without this kind of support. Finally, the white brain material, which is much more compact and seems to need less supporting material than the gray substance, contains neuroglia-cells in much larger amount.

Under the term neuroglia are included at least three kinds of cells,—those of the white brain substance, those of the gray substance, and the perivascular cells which have been described by Golgi. The neuroglia-cells of the white brain material are easily recognizable, being large and with rather prominent, smooth, and sharply outlined processes. As my brother seems to have shown, their object appears to be to furnish an insulating or at least a badly conducting substance to serve as an interrupter of nerve-currents. They certainly do not represent interstices of true nerve substance through which lymphatic fluid can conveniently find its way.

The neuroglia-cells of the gray matter present a very special and highly characteristic appearance. They are of manifold form,—at times star-shaped, at times like a comet drawn out in length. These are the tail cells of von Retzius. They have very numerous prolongations, with a large number of short branched collaterals, which give the whole cell the appearance of having feathers projecting from its periphery. These cells have been observed in two different conditions. One is that of relaxation, and the picture is that given above. The other is that of contraction, during which the

cell-body has more protoplasm in it, and the processes become shorter and thicker and some of the secondary branches disappear entirely. These cells resemble, in certain ways at least, the pigment-cells which occur in the skin of some animals. By means of their contractility, these pigment-cells can stretch out their processes while in a state of rest and can draw them in while in a state of contraction. It must be remembered that this form of neuroglia-cells is most abundantly present in those parts of the brain in which it might be expected that a number of nerve-currents would frequently come together. They occur, for example, with special frequency in the molecular layer of the cerebral cortex, where the bundle of pyramidal fibres, with their immense number of terminal nerve-endings, come in contact with one another.

The third form of neuroglia-cells consists of those known as the perivascular cells. They are found only in the neighborhood of the capillaries of the gray matter, and they send one or more firm prolongations to the outer surface of the endothelium of the blood-vessels.

These processes are inserted in the walls of the blood-vessels. Every capillary has thousands of these little pseudopod prolongations, and from the vessel the cell reaches out in a number of directions. The object of these cells undoubtedly is by contraction of the prolongations to bring about local dilatation of the blood-vessels. This dilatation of the blood-vessels causes greater or less intensity of the psychical processes in certain parts of the brain, because of the greater or less congestion of the circulation in a part which it produces.

With the exception of these last cells the object of the neuroglia-cells is to insulate nerve-fibrils and cells from one another. When the cells are relaxed, the passage of a nerve-current is either entirely prevented or rendered much less easy than before. It is in this way that the true nature of intellectual rest is explained. Sleep—not only natural sleep, but also artificial narcosis, such as is produced by narcotics, hypnotics, or hypnotization—is evidently the result of the same conditions.

During the state of contraction the pseudopods of the neuroglia-cells are drawn in,—that is to say, the protoplasm of the cells absorbs the processes, and so the true nerve-cells and nerve-fibrils which were separated from each other by the interposition of neuroglia

come into contact. By this mechanism the brain passes from the condition of rest into one of activity. These neuroglia contractions may, particularly in certain parts of the brain, occur automatically. Often, however, they are produced by the action of the will, which in this manner is able to influence the definite groups of neuroglia-cells. As the result of this influence of the will, the association of intellectual operations can be guided in various directions. The unusual course that the association of ideas sometimes takes, the flow of words and of thoughts at certain moments, the passing difficulty of speech, the recurrence of tormenting thoughts, the disappearance of expressions or ideas from the memory, even the increase of mental activity and of every kind of motor reaction as well as many other phenomena of intellection, can be satisfactorily explained on this hypothesis. It is only necessary to suppose that in certain parts of the brain the neuroglia-cells are at rest while at other parts they are in a condition of active contraction.

To put it all in a few words, the neuroglia-cells of the gray substance of the brain represent an isolating and switching apparatus for nerve-currents. They are an isolation apparatus when in a state of contraction, a switching and insulating apparatus when in a state of rest. It is to be remarked, then, that according to this theory the contraction of brain-cells does not take place, as in Duval's theory, during intellectual rest, but, on the contrary, during the state of activity of the cerebral cortex. It is much more probable that the action of cells coincides with the active stage of intellection than that brain cellular activity— that is, contraction— should correspond with psychic rest.

THEORY OF ATTENTION.

Under usual conditions the motor apparatus of the gray matter suffices for the explanation of the varied course of association of ideas and of the reaction produced by voluntary motion. But as soon as attention is concentrated upon an idea or a small number of associated ideas, there enters into the problem, besides the active retraction of the neuroglia of the corresponding part of the brain, a new factor,—the active congestion of the capillaries of the over-excited region. As a consequence of this, the energy of emotion reaches a maximum. The heat and metabolism of the hyperæmic

parts is increased, which, of course, makes these parts capable of more work.

This congestion of various parts of the brain has been experimentally observed by a number of physiologists. It can be best explained by considering that the will has an influence upon the nerves which produce a dilatation of the blood-vessels in different parts of the cerebral cortex. The process of attention, however, by which intellectual activity is concentrated upon a limited number of ideas, seems to be but very little under the control of the sympathetic nerve endings.

As a matter of fact, the capillaries of the brain are wanting in nerves and smooth muscle-fibres. Hence they are not under the control of the sympathetic system. Only the relatively large arteries of the pia mater, which possess a tunica muscularis, are under a certain limited control of the sympathetic, which is able to produce in them an incomplete and not very well-limited congestion. One of the difficulties of the problem of the activity of the sympathetic is best realized when we recall that vasomotor activity is usually involuntary. The process of attention, however, is entirely conscious and voluntary.

In the hypothesis that we have given most of these difficulties disappear. Under the influence of the will, the pseudopod branches of the neuroglia-cells which end in the walls of the capillaries contract. As the result of this, the blood-vessels, all of which are surrounded by lymph-spaces, dilate, and this dilatation may proceed to such an extent that the vessels occupy the whole of the lymph-spaces. Thus we can easily understand how the very limited congestions which are necessary for the concentration of thought upon a single idea may be brought about.

The perivascular lymph-spaces which exist in the brain seem to be for the purpose of making these limited hyperæmias easier. At the same time they serve a very useful purpose in preventing pressure or concussion, such as might be caused upon the neighboring nerve-cells by too great dilatation of the blood-vessels of a part.

It is needless to add that we do not consider the hypotheses that we have advanced to be absolutely without objection. On the contrary, we believe that, owing to the difficulty of the problem and our as yet extremely slight knowledge of the anatomy and physiology of the nerve protoplasm, any theory as to the special mechanism of

psychic processes is sure to be faulty. Rational hypotheses, however, which are supported by well-known facts are not only justified, but are often fruitful of suggestive ideas. A scientific hypothesis often gives a new direction, suggests an untried method of observation, or hints at new ways of experiment, and, though it may not lead directly to truth, always brings us closer to methods of investigation and of criticism that are invaluable. Even though our further investigations should not confirm our hypotheses, the result will not be less positive. Negative conclusions lessen the number of possible hypotheses and, therefore, lessen the possibility of error in future investigations.

MOVEMENT THERAPY FOR LOCOMOTOR ATAXIA.

TWO CLINICAL LECTURES DELIVERED AT THE SALPÊTRIÈRE HOSPITAL, PARIS.

BY H. S. FRENKEL, M.D.,

Inventor of the Systematic Movements for the Cure of Incoördination and Director of the Freihof Sanitarium in Heiden, Switzerland.

LECTURE I.—COÖRDINATION: ITS CAUSES AND COMPLICATIONS.

GENTLEMEN,—In no department of medical practice does the practitioner feel more helpless, as a rule, than in the treatment of nervous diseases. An affection like tabes, for instance, begins in a comparatively young man, runs an inevitably progressive course, and the physician is able to do nothing to hinder its evolution and very little to alleviate its symptoms. When the ataxia becomes so marked that but little exercise can be taken, a most trying ordeal develops for the doctor and his patient. Often, though the general health remains quite good, patients become absolutely bedridden. It was the uselessness of drugs in the treatment of these cases that led to the invention of movement therapy, which has given such good results not only in the hands of its original users, but also in those of well-known neurologists all over the world. Tabetic patients who are seemingly helpless from the incoördination may be retaught to make the movements which their disease has gradually put beyond their power.

In recent years many observers have been coming to realize that incoördination could be lessened by the practice of movements. A rather characteristic story is told of one of the great German neurologists. He wished to present to his class a series of tabetic patients each of whom suffered from a special form of incoördination. In order to be sure that the demonstration would furnish definite and contrasting types of ataxia, he examined a large number of patients beforehand, and selected those who presented the most striking examples of certain incoördinate movements. The patients were told that they would be brought before the class next day, and that each would be asked to perform a certain set of

movements which best brought out the special form of ataxia characteristic of his case. The patients were, quite naturally, a little nervous about the success of the demonstration for the next day, and so they practised the movements they were to perform after the rehearsal. As the result of the practice, most of them lost their characteristic incoördination. The patient, for instance, who required four or five dabs at his nose in order to reach its tip could the next morning reach it almost at once without much effort. One who presented a striking example of titubation when he attempted to walk a crack could before the class walk it reasonably well. The professor could not at first understand why his carefully prepared demonstration failed so egregiously. But a precious lesson had been learned in the matter of the symptomatic therapeutics of locomotor ataxia.

I shall present to you some patients in whom the improvement of coördination is so great as to constitute, in their estimation at least, a practical relief from their most troublesome symptoms.

This first patient, a man of forty-five, has suffered from tabes about twelve years. For a number of years he was here in Paris under Professor Charcot's treatment, at whose suggestion he went to the southwest of France to take the waters in the Hautes Pyrenées. He was for a time under Professor Grasset's care at Montpelier. Despite the most careful treatment at the hands of these two eminent specialists, his incoördination constantly grew worse. About a year ago he found that he could not move around at all without the use of two canes, and shortly after that he lost confidence in himself to such an extent that he dared not walk on the street alone. This loss of confidence in their power to use their muscles is one of the most annoying symptoms from which tabetics suffer. Emotion or any shock to their nervous systems, such as a sudden noise or any hint of danger in crossing a street, is enough to unnerve them completely and to make them feel like sinking helplessly to the ground.

The patient now has been under treatment here for some six months. He has not lost all his incoördination. He is able to walk, however, very well with one cane, and he has completely regained his confidence in his ability to take care of himself while on the streets. He is able to go up and especially to come down stairs without the nervous strain that made him hug the balustrade almost

convulsively before he began the therapeutic movements. He himself thinks that the treatment has been most successful. He is very well satisfied with it, and is confident that he is gaining power over his coördination from day to day.

Our second case is a woman whose symptoms of incoördination were even more pronounced than those of the first patient. For six years she was confined to bed here in the Salpêtrière, absolutely unable even to move about her room. This patient was selected by the staff of the hospital here as a test of what movement therapy could do for tabes. For six months now she has been able with the aid of a cane to walk around the hospital and its garden, and has even ventured freely into the streets. This result is a very striking proof of how much can be done for the locomotor ataxic symptoms of tabes, though absolutely no improvement is effected in the pathological basis of the disease.

As is well known, the pathological lesion in tabes is a degeneration of the posterior, or sensory, tracts or columns in the spinal cord. Once this degeneration has taken place, no power is able to restore the nerve substance which has thus been destroyed. That we can improve the symptoms of the disease, however, the two cases that I have shown you and the many others that I shall be able to show you during this course furnish ample proof. The therapeutic method by which this improvement is accomplished and the theory on which it is founded will form the subject of our talk to-day.

COÖRDINATION.

By coördination we understand the working together of a group of muscles in order to accomplish a certain movement. The contraction of the various muscles is often quite different in degree. The muscular contraction, however, must proceed to a certain extent, no more and no less, or there will not be coördination of movement. Coördination, then, is really a regulation of muscular contraction. It is the duty of the muscles, however, not only to cause the movements of the different parts of the system, but also to assure the fixation of the body in certain positions. The weight, for instance, of certain of its parts must be balanced by muscular contractions that prevent movement which might result from the influence of gravity.

When we wish to use the hand, it is usually necessary that the

shoulder and the elbow should be fixed in a certain position. In movements of the leg, as in standing or sitting, the rump muscles must be employed to steady the trunk and enable other muscles to act with freedom. Even movements of the eyes require that the head should be turned in certain directions and the neck muscles used to help vision. Movements, then, which seemingly are controlled by one group of muscles often require the simultaneous action of a large number of muscles lying at a distance from those which are directly employed. So seemingly simple an act as standing is the result of a complicated mechanism requiring the coördination of a large number of muscular contractions.

The factors which produce this coördination of movement are, first, the nervous impulse to the muscle groups whose activity is demanded, second, the extent of their contraction, and, third, the rapidity of the angular movements demanded. This last depends on the rapidity of the course of contraction. It is only by the definite co-operation of these three factors that properly coördinate movements become possible. An anomaly in any one of these elements must necessarily result in a disturbance of movement,—that is, in incoördination.

What criterion have we by which to judge whether these three factors are working undisturbedly together? Only one,—the ordinary gait of a normal man. This assumes that the movement of a healthy organism is just proportionate to the accomplishment of the object for which the movement was begun, and that it is accomplished with the smallest outlay of force and a rapidity which corresponds to the necessity of the case.

It must be remembered that the intentional movements of healthy individuals are not all identical in manner or in the consumption of energy. There are distinct differences in the way in which different individuals accomplish the same action. It is for this reason that we are able to recognize the gait of individuals and their manner of sitting down and standing up, their movements in the dance or while sitting on horseback, or their position when in company with others. In a word, there is scarcely an action which does not bear the stamp of the physical personality. We are able to recognize our friends' footsteps when we are unable to see them. We can distinguish their method of doing things when they are at so great a distance as to be unrecognizable by their features. This

is because of the individual elements that enter into the composition of what we call coördination. It is evident that it is an extremely intricate mechanism, and it is for a disturbance thereof that we must treat the patient. If, then, the treatment require the exercise of patience over a long period of time, it need not be a source of wonder.

ATAXIA.

Ataxia, as we shall now consider it, has reference only to the disturbance of coördination which occurs during the course of tabes dorsalis. For the moment other ataxias are put aside. The simplest form of disturbance of incoördination is that which affects a single joint. It may occur in two forms,—either the movement of a limb is interfered with so far as the accomplishment of a definite action is concerned, or the continuance of a certain movement or the maintenance of a certain position may be prevented. Examples of these two forms of ataxia may be seen in an uncomplicated type in the knee, a joint which allows of motion in but one axis. If when the patient is lying down he is unable to place his heel upon a definite part of the other leg or on some marked part of the couch on which he is lying, the first form of incoördination exists; if when standing he is unable to hold his foot up in the air with knee bent for more than a very short time, the second form is present. This analysis of the forms of incoördination enables us to differentiate ataxic patients from one another and is an important consideration for the prognosis of what may be accomplished by movement therapy.

CAUSES OF TABETIC ATAXIA.

In spite of our constantly advancing knowledge of the pathological anatomical basis and of the clinical picture of tabes dorsalis, the views of neurologists with regard to the causes of the incoördination which is such a prominent symptom of the disease differ so much that it seems almost hopeless to expect any agreement in the matter for a long time. Two points are of especial importance in the discussion. The first question is as to what is the essence of the incoördination and where it is primarily situated; and the second is whether the disturbances of sensibility which admittedly are not infrequent in tabes are constantly present wherever ataxia is to be found.

We have come to realize in recent years that neither the power nor the ability to contract muscles is lost in tabes. The muscular strength is nearly normal, as Duchenne used to demonstrate here at the Salpêtrière, by having tabes patients, who were scarcely able to walk alone, carry other patients on their shoulders when they were guided by some one on whom they could depend to help their coördination. What is disturbed is the harmony of muscular action. According to one theory, the nerve impulses which come down through the spinal cord are not properly directed; the ataxia, therefore, depends upon some pathological change in the centrifugal spinal nerve. As, however, the nerves which carry simple motor impulses are evidently intact, we must assume the existence of a special set of spinal coördination nerve-tracts. In order to make this theory agree with the anatomical lesion of tabes, the degeneration of the posterior columns of the cord, we must also assume as an auxiliary hypothesis that these coördination nerve-fibres, in spite of the fact that they carry impulses in a centrifugal direction, are situated in the midst of a nerve-tract, the posterior or sensory columns, which otherwise carry only centripetal nerves. This supposition is not as unnatural as it seems, for, by analogy with the lateral column, in which the existence of nerve-fibres carrying impulses in both directions has been demonstrated, the double set of nerves in the posterior column would not be so surprising. This theory is not without its difficulties, but is less questionable than are many other theories.

The other explanation of tabetic ataxia, which has many adherents, is the one which attributes the incoördination to the disturbances of sensation in tabes. It is well known, however, that tabetic ataxia may exist without disturbance of sensation, and that disturbances of sensation to a marked degree have been noted in certain cases without a corresponding disturbance of the coördination. It has been assumed by some neurologists, especially of the French school, that an important element in the etiology of incoördination comes from cerebral disturbance. This theory seems to account better than any other for the variations in the symptoms of tabes which are often noted. For instance, such symptoms as anæsthesia, hyperæsthesia, and paræsthesia vary from day to day. Paralyses of the eye-muscles, even motor incoördination, may develop one day and disappear the next, recur and then disappear

once more. Symptoms grow worse and then grow better and at times disappear. The spinal pathological lesion in tabes is constant and constantly progressing. We cannot hope to explain all the varying symptoms of tabes on the assumption that this spinal lesion is the only one present.

We have not been able to demonstrate any changes in the brain, however. It is evident that there are certain, at least functional, disturbances of the higher centres associated with the development of the degenerative process in the cord. These neurotic conditions are not infrequent in tabes, and serve to account, better than any supposed lesion of the higher centres, for the variations in its symptoms. This neurotic or hysterical element in the symptoms of tabes must be taken into account in any method of treatment undertaken for their relief. It is frequently in evidence during the course of the treatment, and must not be allowed to discourage the patient or his physician.

HYPOTONUS OF MUSCLES IN TABES.

A very important and significant phenomenon is the reduction of the tone of the muscles. It is well known, as has been already stated, that the muscular strength is not reduced. The alterations, such as atrophies, paresis of muscles, and the like, which occur during the course of tabes in some patients, are chance complications. Their significance is still under discussion and their presence is interpreted in various ways by different observers. Of the existence of muscular hypotonus, however, there is no doubt, and it is a constant symptom in all well-developed cases. It is particularly noticeable in the neighborhood of joints. Take the hip-joint, for instance. A normal individual while lying supine is not able, if his leg is in an extended position, to lift his limb much beyond an angle of forty-five degrees with the plane of the couch on which he is lying. A tabetic patient can raise it to a right angle, and in some cases is even able to bring the foot completely up to the shoulder and to hold it there. The power to do this is due to the fact that the muscles around the hip-joint have lost their tone and are capable of being stretched much more than ordinarily.

The same lack of muscular tone exists in the neighborhood of other joints. While the knee usually admits of movements in only one axis, or of such slight lateral movements that they are insig-

nificant, in tabetic patients the range of lateral movement in the knee-joints is quite marked. The same thing is true for the ankle and the various joints in the foot, also for those of the upper extremity. The feet of tabetic patients, for instance, can be readily put into positions that illustrate various forms of club-foot. This gives no pain and is scarcely a source of discomfort. Tabetic patients are easily able to carry their arms straight backward until the backs of their hands touch each other. The fingers can be set in various distorted positions without any difficulty or annoyance.

This hypotonus of muscles, especially around joints, is important for two reasons. First, it represents the cause, or at least the occasion, for the development of tabetic joint arthritis. In the wabbling joints of patients suffering from arthritis, opposing joint surfaces are brought together in such a way as to produce lesions in the joint structures. This is followed by effusion into the joint. A series of such intra-arthral lesions produces the clinical picture known as tabetic arthritis. The lowered sensibility of patients suffering from tabes allows the process to become severe and sometimes excessive before attention is called to it. Tabes patients should always be warned, then, of the risk they run of having arthritis develop, and special directions should be given them, so that the arthritic process may not become extensive before proper attention is given to it.

This lowered tone of the muscles forms one of the important points in the prognosis as to the success of movement therapy for the incoördination. Where the muscular hypotonus is excessive, the question of proper coördination becomes much more involved than in the form of the disease where the muscular tone is reasonably well retained. Almost from the very beginning of treatment, then, a reasonably good idea can be formed of the amount of improvement that can be brought about in the patient's condition by movement therapy. The examination of the muscular hypotonus constitutes the best criterion for prognosis.

SENSATION AND ATAXIA.

For the accomplishment of coördinate movements it is indispensable that the movements should be performed under the constant direction of sensation. We learn to regulate our actions by noting the effect produced by certain nerve impulses, and then still

further directing nervous influences for the end desired. We use our sensations not only while learning movements, but also in performing them after they have been learned. When our normal sensations are disturbed, disturbances of movement occur. When sensation is only diminished, lessened power of directing movement results. Where total anæsthesia exists in muscle groups, paralysis should result. This part of the theory of the connection between the disturbance of sensation and the incoördination of tabes has been confirmed by experiment. By complete section of the posterior nerve-roots in animals—a lesion which would, of course, be followed by total anæsthesia—Sherington and Hering produced true paralysis in the affected limbs.

The influence of vision upon disturbances of coördination is easily explained on this supposition of the necessity for sensation to guide movement. Observation on normal individuals shows that under the guidance of sight movements are rapidly accomplished which in the dark are performed only gropingly. Standing, for instance, is a complicated problem of coördination. When the muscular sense and the cutaneous sensibility are lessened, then, if vision does not replace these sensations, the Romberg symptom, the swaying with the eyes shut, occurs. This shows that sight can be used to replace other sensations.

This principle of employing vision to help coördination constitutes the basis of exercise therapy for tabes. Walking, standing, and other complicated movements, which have become habitual under the guidance of sensations that are dulled in cases of tabetic degeneration, become difficult to accomplish. The use of a new sense, that of sight, for their guidance requires long practice, which must be carefully directed. When the child is learning to walk and to assume various positions, the whole of its attention during waking moments is unconsciously devoted to ascertaining the significance of sensations and the proper reflex response to make to them, in order to direct the movement properly or retain positions without change.

As a rule, sufferers from tabes are too impatient to practise these movements under the guidance of sight thoroughly by themselves. Besides, they lack the confidence in the ultimate result that would encourage them to keep up these exercises from day to day until facility in their accomplishment is once more acquired. This,

then, is the duty of the physician. He must reteach various movements. Exercise therapy for tabes does not mean that patients must exercise their muscles, as in the ordinary acceptation of the word "exercise." Exercise therapy is the direct contrary of this. The patient must never be allowed to fatigue himself. Movements must not be repeated in a careless fashion with the idea that the mere repetition of them, no matter with how little attention, will bring improvement. The essence of the treatment consists in having them performed exactly. They must not be done many times, but must be executed each time with very great care. Failure to obtain improvement after the employment of exercise therapy for tabes is nearly always due to the fact that the signification of the word "exercise" is mistaken, and that not exact movements, but movements in general, are recommended to the patient.

LECTURE II.—METHODS OF TREATMENT.

Every individual suffering from tabes presents a special set of symptoms and requires special treatment. The movements for one person are not those which will give the best satisfaction for another. When the incoördination is very severe and the patient is confined to bed, the exercises must be taken in the lying position. He is asked to put the heel of one foot on the other leg, touching now the front of his ankle, next the middle of his shin, and then his knee-cap with his heel. Before any movement is begun it must be definitely understood what the patient is going to do, and then he must perform it as exactly as possible.

The same movement must not be repeated frequently, because it tires by repetition, the attention becomes distracted, and the movement is accomplished less exactly than before and consequently with less benefit to the patient. It must be remembered that, owing to the absence of the ordinary sensations which enabled him to guide his movements before tabes set in, the performance of exact motion by the tabetic patient requires a very greatly increased effort of attention, that very soon becomes wearisome. This weariness must be always looked for, and the patient's faculty for attention must never be abused by over-exertion.

At the beginning of movement therapy, after a movement has been accomplished from two to four times another should be begun, or, better still, movement with the other leg should be directed. At

first the exercises should not last for more than five minutes and should not be repeated more than three times a day. Patients should not be allowed—at least not counselled—to practise the movements by themselves. They would then do them with less exactness than is necessary if they are to derive any benefit from them, and they would be likely to overfatigue themselves. It is better to have the movements done only twice a day under the watchful care of some one who realizes their exact purpose than to have them repeated oftener without due regard to accuracy in their accomplishment.

At the beginning particularly the first sign of weariness should be the signal to stop the exercises. If patients have been in bed for some time, muscles will be atrophic for lack of exercise and will be especially ill adapted for the performance of continuous movements for more than a few minutes. For these patients some massage may be advisable, to get their muscles into good functional condition once more.

Besides these movements of touching parts of the other leg, patients may be directed to touch various points of the foot of the bed, or to set their heels in grooves which have been cut in a plank for that purpose. Or they may be asked to touch with their toes one of a set of balls that hang down over the bed. Not much apparatus is needed, and the simpler the apparatus the more effective it is, as a rule, if it only secures accuracy of movement.

After the patients succeed in executing these movements in bed for some time and their muscles have become used to acting once more, they may be counselled to sit on the side of the bed and to use their feet in various well-defined movements. They may touch portions of a chair that is set before them, or may place their feet in various positions on the floor, putting a certain amount of their weight on their legs. After some time they will be able to stand up, and then they must be directed to move their feet into definite positions that have been accurately pointed out to them beforehand.

Tabetic patients of all kinds should be taught the movements necessary for walking as completely as if they had never known how to walk. The places where the feet are to be put, one after the other, should be marked on the floor, and each foot should be set down as accurately as possible in the place determined for it. Where many patients are to take exercise in a room, a long dark

stripe about fifteen inches wide may be made. On this the feet should move, one after the other, in steps of equal length. The movement must be done slowly and deliberately: there should be no haste and no uneven movements. The foot should swing forward like a pendulum, and not be given successive little pushes to the place marked out for it. This trick of accomplishing a single movement by a series of efforts is very common in tabetic patients, and care should be taken to overcome the habit. It is, of course, due to their disease, but it is one of the symptoms that movement therapy must ameliorate.

When patients can only just stand on their feet, they should be made to perform various movements of but small extent. The right foot, for instance, may be moved a few inches forward, next a few inches to the right, then a few inches backward. As the power of balancing becomes better, these movements can be made longer. Each foot should, of course, be exercised. At first the patient must accomplish these movements under the direct guidance of vision; after a time, however, the formation of a habit will enable him to perform them with the eyes fixed at some distance from his feet; after still further exercise he may even raise his eyes to a level with the horizon and yet perform them with confidence and accuracy. Always, it must be remembered, the object of these movements is not frequency of repetition, but accuracy of movement.

CONTRAINDICATIONS AND PRECAUTIONS.

There are certain conditions that contraindicate treatment of tabes by movement therapy. If the disease is in an acute stage and the symptoms are developing rapidly, it will usually be found that the movements fatigue the patient, do very little good, and fail of their purpose of decreasing incoördination.

Movement therapy is contraindicated also whenever there is meningeal irritation, which produces certain symptoms that make it rather easily recognizable. There is a dull painful paræsthesia of varying, though usually not very great, intensity, which exists almost continuously in the muscles of the back, or sometimes in the muscles of the arms and legs. This spinal irritation may begin at any time in the course of tabes, but usually occurs during acute stages of the disease. In most cases it disappears after a few weeks. It is sometimes regarded as a fresh exacerbation of the

morbid process, and is often followed by a deterioration in the sensibility, while the incoördination also grows worse. It is not, however, very frequent, and seldom persists during the whole course of the disease; patients in whom it does, experience teaches me, are not suited for this form of treatment.

Though it has been said that frequent tabetic crises contraindicate the use of movement therapy, the statement has not been confirmed by my experience. The painful condition usually lasts but a few hours, or at most a day or two, and as soon as relief comes the treatment may be resumed. A number of patients who have been under my care during long periods claim that movement therapy is a very helpful remedy against the frequent outbreak of tabetic crises, and that not infrequently faithfulness at the exercises seemed to lengthen the period between successive attacks and make them much shorter when they did occur.

The presence of a heart lesion does not contraindicate the employment of movement therapy. Of course more care must be taken in choosing the movements and in determining the length of time for which they are to be taken. Constant watch over the pulse, which is a good precaution in all cases where tabetics are being exercised, is indispensable whenever a heart lesion exists. So long as the pulse does not return to its normal frequency the physician must not allow the patient to renew the exercises. A distinct rise in the pulse-rate during any single exercise is an indication that it should not be continued. The mere fact that the patient does not feel tired and assures the physician that he is ready to resume the movements is not sufficient reassurance in these cases. Tabetic patients have lost their true sense of fatigue, and their assertions in this matter have not the usual significance.

During the exercises the patients must be carefully guarded from falls or injuries of any kind. This is a much more important matter than it is sometimes thought to be. A single severe fall will completely destroy a patient's confidence in himself and make the exercises of no avail, because fear will prevent the proper application of attention. Again, the bones of tabes patients are often so brittle that even a slight fall may result in a fracture.

It is especially important that the exercises should be intermitted at the first sign of the occurrence of tabetic arthritis. This inflammation results from the hypotonic condition of the muscles

around a joint, which permits intra-articular irritation to be produced by too close contact of its surfaces during movements. The patient should be warned, then, of the necessity for noting the condition of his joints, so that tabetic arthritis may not go too far before rest for them is secured.

Where possible, it is advantageous to have tabetic patients exercise together. A certain amount of competition affords an excellent stimulus. By mutual progress patients are encouraged to continue the regular movements much more hopefully. Into these exercises in common certain principles that are very important for the accurate performance of the movements can be more thoroughly introduced. For instance, movements may be done at a word of command and may be required to be accomplished in a definite time and with a certain rhythm. This enables patients to overcome, better than in any other way, their tendency to perform actions not continuously, but by a succession of almost unconscious and almost unnoticeable smaller movements. Thus, walking, especially the more difficult act of walking towards one side, may be a great help to general coördination when done in this way.

INCOÖRDINATION OF ARMS AND HANDS.

In certain cases of tabes there is a marked incoördination in the movements of the upper extremities. A symptom of which patients complain most bitterly is the change in the character of the handwriting which results from the ataxia. This trouble is often very amenable to exercise therapy. The patient must begin by tracing various geometrical figures and curved and sinuous lines just as he did when learning to write originally. As a rule, marked improvement will occur in the handwriting after a certain amount of practice of this kind. Another common symptom is an inability to grasp door-knobs or keys or to touch bells without groping for them. These symptoms can be relieved by a course of exercises in touching objects placed in rows or balls swinging from a cross-bar, or by lifting plugs from a set of holes in a board and replacing them in other positions.

Practice of the movements with the hands must be made as accurately and as definitely as is counselled for the feet, if success in relieving the symptoms is to be obtained. Patients can be exercised in buttoning their garments, and so regain a facility which is

sometimes lost at an early stage of the disease and which leaves them dependent on the care of others.

APPARATUS REQUIRED; NATURAL AWKWARDNESS.

To many who have taken up movement therapy for tabes the question of apparatus has seemed very important. Scarcely a week passes by that one does not hear of the invention of some new mechanism calculated to enable patients to exercise themselves in certain movements. Very little apparatus is needed, as a matter of fact. As I have said, marks may be made on the floor to direct the patients just where to place their feet. A strip fifteen or sixteen inches wide may be used to enable them to overcome the habit which tabetics usually have of walking with their feet wide apart. On this strip foot-marks may be made so that the patient shall set his foot down on them at each step. This assures regularity of gait, precision of movement, and accuracy in the execution of a definite purpose. As patients improve, harder tasks may be imposed by having them walk zigzag or broken lines, their feet being put down in positions that do not follow one after the other in a straight line. For these the doctor's judgment and the patient's needs will be the best guides.

A most difficult thing for tabetic patients to do is to walk downstairs. Sometimes one of the first symptoms of tabes is the sinking that occurs during the performance of this act. In order to restore to patients their confidence in themselves they should be exercised in descending stairs. For this purpose a small set of steps with a hand-rail may be used in office practice. Other apparatus is scarcely necessary. Some of the best and most surprising results have been obtained absolutely without apparatus. The principle must ever be borne in mind that it is not a muscular exercise that the tabetic needs, but exercise of his attention and of the auxiliary sensations which will eventually replace his muscular and cutaneous sensibility in order to enable him to control his movements.

Normal individuals differ very materially in their facility in performing complicated movements. Some people are unable even to accomplish certain simple movements except with difficulty. Such persons are said to be awkward. If an awkward man acquires tabes, his incoördination will be very marked. His nervous system originally could scarcely guide his movements with perfect coördination; hence he will not under any treatment regain his coördina-

tion to the same extent as an individual who was never clumsy. The nervous system of the awkward man permitted some appearance of ataxia even in health. After tabetic degeneration has taken place, this ataxia will be necessarily very marked and persistent.

ADDITIONAL PRECAUTIONS AND DIRECTIONS.

In different parts of the room where walking it to be practised light chairs should be placed, which patients may at any given moment take hold of for support. It is much better that this should be done from the very beginning of the exercises than that a patient should be allowed to carry a cane. The right use of the cane, which is meant to give confidence rather than to serve as an actual support, should be taught later. Patients do not of themselves learn its proper use and trust too much to it.

We cannot too strongly emphasize the fact that tabetic patients are liable to sudden losses of confidence, in which their muscles give way completely and they sink in a heap. If this should happen at the beginning of the exercises, it delays improvement very much. Slowness of movement, we have insisted, is one of the means to give patients confidence. Then they must be taught to stop at a word of command, which should be given at unexpected moments. Another good exercise is walking backward; this is much more difficult than walking forward and should be practised very carefully. It must not be regarded as a mere fad, but constitutes an essential part of the treatment. The patient should not be allowed to attempt long steps while going backward, because such effort is at once too difficult and fails to answer the proper purpose of the exercises, which is control of muscles.

Tabetic patients should be practised especially in changing their direction when walking. Ordinarily those suffering from ataxia make a large curve in turning a corner; they should be taught gradually to reduce the radius of this curve by the practice of turning at command, definite positions for the feet being indicated. Tabetic patients usually turn much better in one direction than another; hence care must be taken to exercise them in both directions.

The secret of success in the movement therapy of incoördination is that the exercises must not be performed in a routine manner, but must be applied differently to different cases. Each patient is an individual and his set of symptoms are absolutely his own. The treatment must be individual and adapted especially to each case.

LOCOMOTOR ATAXIA.

CLINICAL LECTURE DELIVERED AT THE VANDERBILT CLINIC.

BY M. ALLEN STARR, M.D., LL.D.,

Professor of Diseases of the Mind and Nervous System, College of Physicians and Surgeons, Medical Department of Columbia University, in the City of New York.

Gentlemen,—The first patient whom I present to you to-day (Case I.) is a man, aged forty-two, who had syphilis at the age of twenty, with secondary symptoms, but has had no tertiary symptoms of the disease. He has been a clerk and has not taken an undue amount of exercise or had any particular mental, nervous, or physical strain. He says that he has suffered for the past two years from sensations of undue fatigue and from a feeling of numbness in his feet and legs extending as high as the middle of the thigh in front, that in the past year he has become somewhat awkward in his gait, and that occasionally he has stumbled and fallen when walking about his room in the dark. During these two years he has noticed a gradual loss of sexual power and some difficulty in micturition, there being a delayed action of the bladder. He suffers also from chronic constipation. He has had no pains of any kind; he has no sensation of a band about his waist; his general nutrition has been very good; he has not suffered from insomnia; his eyesight is perfect. In fact, his complaints are chiefly of numbness and of awkwardness in walking.

Examination shows no evidence whatever of anæsthesia in the feet or legs or on the body, but we find a loss of knee-jerk, and when he stands with his feet together and eyes closed he presents a noticeable swaying of the body. When he pays attention to his walking his gait is steady and firm, but when he is asked to rise from a chair suddenly and take a step forward he is manifestly unsteady. If he attempts to walk backward his steps become irregular in length, and when he attempts to walk with his eyes closed the same irregularity is evident. The coördination of movement in his hands is

perfect. His pupils are of normal size and do not react to light, but react perfectly in accommodation.

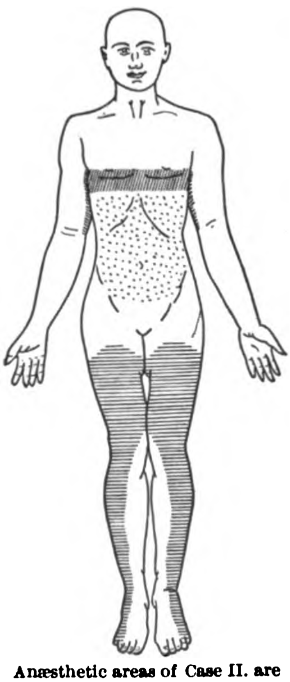
This patient, then, presents very few symptoms of locomotor ataxia, but he does present the three characteristic physical signs of the disease,—loss of knee-jerk, swaying with eyes closed, and the loss of reflex of the pupil to light,—symptoms that have been termed, respectively, Westphal, Romberg, and Argyll-Robertson symptoms, but which I prefer to term the physical signs of the disease.

Case II.—In contrast to this patient, I present to you a second case,—a man, forty-two years of age, who denies absolutely any history of syphilis and does not present any questionable symptoms which might excite a suspicion of that disease. He is able to walk in quickly and briskly to the clinic, and if you watch his motions you see that there is no evidence whatever of ataxia. He tells us that he has been perfectly well except for occasional attacks of rheumatism, for which he has been treated during the past year and a half. When we question him with regard to these attacks, it is evident that they have never been typical attacks of rheumatism, but that by the term rheumatism he indicates a series of pains which are much more neuralgic in character. They began in his thighs, between the groin and the knee, and after remaining there for six months extended downward to the outer side of the calf and have lately reached the outer side of the foot, always having been worse in the right foot than in the left. The attacks of pain are sudden and unexpected. They last but a second, so that before he can put his hand upon the painful spot the pain is gone. But they come in series, so that for several hours he will be attacked every few minutes by a severe darting pain, that is so distressing as to make him jump and will awaken him from sleep or prevent him from going to sleep. He says that these pains are much worse in damp weather, and he has noticed that he can always predict a storm by the increase in the amount of pain. He suffers from them more in cold weather than in the summer time, and last summer he was free from pain for two months continuously. He suffers from cold more than he formerly did, and he says that it is impossible for him now to take a cold bath on account of the intense distress which cold water produces when applied to his legs. He has no similar distress when placing his hands in cold water.

In addition to these pains he has noticed some loss of sexual

power and also a disturbance in the action of the bladder. Sometimes it is impossible for him to urinate, at other times it comes too suddenly, and at no time for the last six months has the action of the bladder been absolutely perfect. During the past three months he has perceived a sensation of numbness about his waist and a hypersensitive condition of his entire body, so that his clothing is at times very irritating to him and a slight touch upon the trunk is enough to produce considerable distress. In a bath, for example, he dislikes very much to rub his body with a coarse towel, on account of the sensitiveness of the skin. Twice in the past year and a half he had attacks which he describes as colic. He was seized with a sudden severe pain in the region of the stomach, and, though he experienced no nausea, he ejected the contents of his stomach on both occasions, and then for two or three days vomited everything that he had taken into his stomach. These two attacks exhausted him very much, so that he was in great distress. During the past year he has emaciated progressively and now weighs twenty pounds less than he did two years ago. He does not complain of any other symptoms.

FIG. 14.



Anæsthetic areas of Case II. are shaded.

Physical examination shows a marked loss of sensation to touch, temperature, and pain down the front of the thigh and the outer side of the leg and foot, in the region corresponding to the sensory area assignable to the second, third, fourth, and fifth lumbar segments of the spinal cord. (Fig. 14.) The area of skin innervated from the sacral region of the cord is not affected in any way. Over the trunk there is hypersensitiveness of the body to touch, temperature, and pain, especially to cold, and around the body, about the level of the fifth rib in front, under the armpits, and over the middle of the scapula, we find a region, about two inches broad, which is quite anæsthetic to light touch, but in which temperature and pain are still perceived. This anæsthesia to touch

extends down on the under side of the arm from the armpit nearly to the elbow in a tongue-shaped area. In all this region the touch of cotton is not perceived at all, and even the touch of the fingers is much less clearly felt than in the adjacent region.

Further examination shows loss of knee-jerk and Argyll-Robertson pupil, but this man has no Romberg symptom and no ataxia. The physical signs, however, together with the symptoms, make the diagnosis of locomotor ataxia evident, and it is probable that his so-called attacks of colic were really attacks of gastric crises.

Case III.—The third patient whom I present to you is a woman, forty-five years of age, who presents distinct evidence of having had syphilis, though she is not herself aware of the fact. Three years ago this woman began to notice a failing of her eyesight, and this increased slowly but steadily until at present you see that she has to be led into the clinic by a friend, and examination shows that she is almost totally blind. With the right eye she can still perceive light and distinguish the presence of a person in front of her, between herself and the window, but she is no longer able to recognize a face or to see any letters whatever of the test card. Her left eye is entirely blind. Her pupils are very much contracted,—almost pinpoint in character. An ophthalmoscopic examination reveals white atrophy in both optic disks, which accounts for the blindness. The minuteness of the pupil prevents any very evident test by exposure to light, which causes no visible contraction, and there is no dilatation of the pupil when the eye is darkened. This woman has had considerable headache, some general disturbance of her general health, lack of appetite, and constipation, and she is very much depressed by her blindness. She has not had any other symptoms, so far as she is aware, though she admits having had some numbness of her fingers occasionally during the past three months. She has no disturbance of gait and has had no lightning pains. Careful examination, however, shows that the knee-jerk is absolutely lost, but there is no area of anæsthesia present anywhere. Her bladder and rectum are normal. She has had no crises.

This case, then, presents a contrast in many respects to the other two cases presented, and yet the disease is undoubtedly locomotor ataxia of a type which begins in the optic nerve. While these three cases are very different as to their onset, the terminal stage in all will be very nearly the same, although the rapidity of progress in the

development of symptoms may be different, and I therefore show you a fourth case in which the disease is at its height.

Case IV.—This patient, a man, aged fifty-six, comes in, as you see, with the aid of a cane and the support of a friend, and walks with very great difficulty in spite of assistance. You notice that in stepping he throws his feet high in the air, that they come down with a stamp, that they are most irregularly placed, his steps being at times longer than necessary and at other times too short. The irregularity of his gait is such as to make him constantly lose his balance, and it is evident that without assistance he is unable to step or stand. He sinks into the chair suddenly, his legs apparently giving way under him, and any coördinated movement of his feet is impossible. He cannot touch his toe to my finger as it sways from side to side and cannot be held steady. His attempts to touch one heel to the opposite knee do not succeed. When, his eyes being closed, I take his feet in my hands and cross them, first the right above the left, then below, then above, then below, and then hold them still, he is unable to say which foot is uppermost. He has no knowledge of the position of his feet in space unless he sees them. This is a state of most complete incoördination, and you see that the same condition is present in a milder degree in his hands. If with his eyes closed he is told to place the forefinger of his right hand upon his left ear, upon a button of his coat, upon the tip of his nose, or to find the index finger of his left hand with it, he makes irregular motions and does not attain the point desired. Such finer acts as that of writing are wholly impossible, even with the aid of eyesight. His knee-jerks are absolutely lost; his pupils, as you see, are contracted to a pin-point and do not react to light, though they act slightly in accommodation. He has, therefore, all the physical signs of an extreme condition of locomotor ataxia. He tells us that he has been ill seventeen years, that his disease began with severe pains and numbness in the feet and legs, that these pains continued to be very severe until three years ago, since which time he has had very little pain in the legs, but has had some in the arms. He has had a progressively increasing disturbance in the action of the bladder and rectum, so that now it is necessary to empty the bladder by catheter at regular hours and to empty the rectum by enema. He has never had any disturbance of his stomach, or any blindness; he is, however, subject to occasional attacks of severe choking and coughing,

with a sense of suffocation, which on one occasion was so severe that his physician proposed laryngotomy, but the spasm finally yielded to hypodermic injections of morphine. The last attack of this character, which was evidently a laryngeal crisis, occurred two months ago. You will notice that he is considerably emaciated, and he tells us that his former weight was forty pounds greater than the present. He has had for nearly a year an obstinate sore on the ball of his right foot, and you see when I remove his stocking that there is at this point an ulcerated surface in the centre of which a sinus exists, and I can thrust a probe into this sinus and feel at the bottom of it dead bone. There is a thin discharge from the sinus, which has not yet been healed by the various ointments that he says have been used. It does not give him any pain; in fact, he has lost all feeling in his feet, and does not appreciate sensations of touch, temperature, or pain below his knees. Sensation is much impaired up to the line of his waist, also in his hands, especially on the inner surface of the arm and in the little and ring fingers. The actual power in his legs is fairly good. There is no true paralysis, but his legs have grown thinner during the past two years.

This man, then, presents the chief features of the later stage of locomotor ataxia, and, although he is not in any sense of the word paralyzed, yet his incoördination is so extreme as to render him incapable of active movement.

These cases present the chief features of locomotor ataxia. The symptoms of this disease are exceedingly numerous, but, as you see, no one case exhibits all of them. If we study a large number of cases and tabulate the symptoms in the order of their frequency, we find some interesting facts.

The following statistics were drawn up by Dr. A. Bonar, one of the clinical assistants, from two hundred and eighty-six cases which have presented themselves at this clinic during the past ten years. The symptoms observed were as follows:

Absence of knee-jerk	258	cases	Girdle sensation	139	cases
Romberg's symptom	226	"	Loss of muscular sense	81	"
Lightning pains	220	"	Crises	48	"
Argyll-Robertson pupil	218	"	Optic atrophy	25	"
Disturbance in the bladder mechanism	178	"	Joint affections	6	"
Paræsthesia	156	"	Perforating ulcer of the foot	4	"
			Muscular atrophy	4	"

This list will give you a fair idea of the relative frequency of the different symptoms in different cases of the disease. Of the two hundred and eighty-six cases two hundred and forty-one were males and forty-four females. The age of onset was between thirty and forty years of age in one hundred cases; between forty and fifty years of age in eighty cases; and between twenty and thirty years of age in only forty-three cases. Syphilis was positively or probably present in one hundred and ninety-eight cases, and was denied and improbable in eighty-eight cases. The duration of the disease had varied from one year to thirty years.

Pathology.—The general adoption of the neuron theory has modified to a considerable degree our view of the pathology of locomotor ataxia, and, in fact, of the nature of the so-called system diseases of the spinal cord. It has always been something of a mystery why the lesion in locomotor ataxia should be definitely limited to the posterior columns of the spinal cord. Recent more careful study by improved methods of staining has demonstrated that this lesion does not involve all the fibres in the posterior columns, but that there remain, even in the most extreme cases of locomotor ataxia, two tracts entirely free from the lesion,—namely, the septo-marginal tract or oval field of Flechsig, lying adjacent to the posterior median septum in the sacral and lower lumbar region and nearer to the dorsal periphery of the cord in the dorsal region; and, secondly, the cornu-commissural tract of Marie, a tract throughout the length of the cord lying adjacent to the posterior commissure in both the columns of Goll and Burdach.

I show you here a series of sections[1] taken from two cases of locomotor ataxia which demonstrate the lesions that are found in two very different types of cases. In the first series of figures, taken from a case carefully studied in Obersteiner's laboratory,[2] you see the lesion as it is limited to the sacral and lumbar regions of the spinal cord. It consists of a sclerotic condition with degeneration of the nerve-fibres in the column of Burdach from the sacral (Figs. 1, 2) up to the upper lumbar region (Figs. 3, 4), where normal nerve-fibres are seen coming into this area in Fig. 4. A section from

---

[1] These sections were thrown upon a screen by a stereopticon.

[2] Dr. Frederick Pineles, Arbeiten aus dem Institut für Anatomie und Physiologie des Centralnervensystems an der Wiener Universität, Prof. H. Obersteiner, vol. iv. p. 341.

Fig. 1.

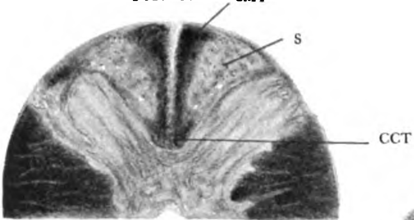


Fig. 2.

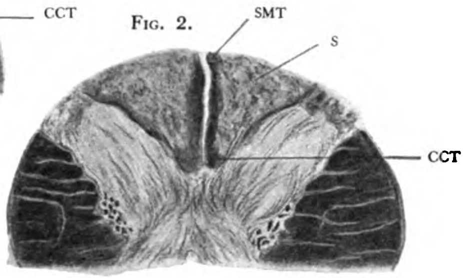


Fig. 3.

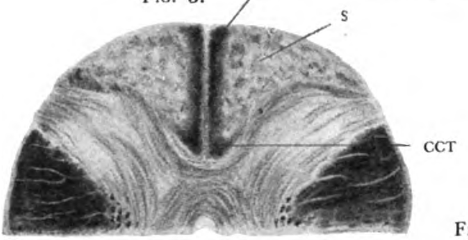


Fig. 4.

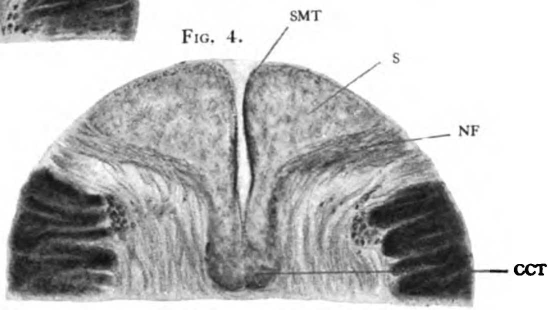
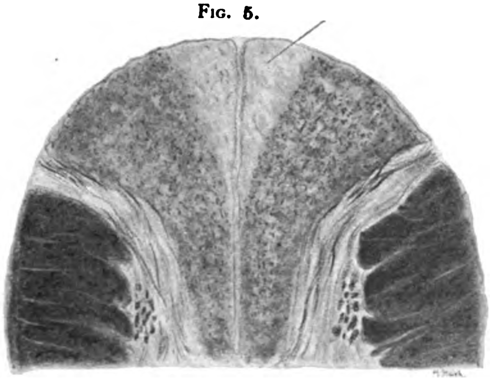


Fig. 5.



Series of sections from case of locomotor ataxia of lower enlargement.

Fig. 1, lower sacral region.—CCT, cornu-commissural tract; SMT, septo-marginal tract; S, sclerosis. Fig. 2, upper sacral region. Fig. 3, lower lumbar region. Fig. 4, upper lumbar region.—NF, normal fibres. Fig. 5, lower cervical region.

FIG. 6.

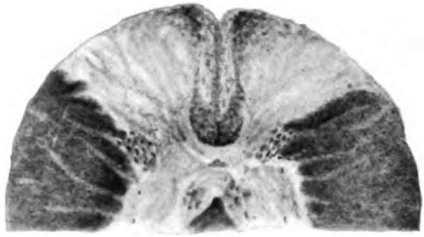


FIG. 7.

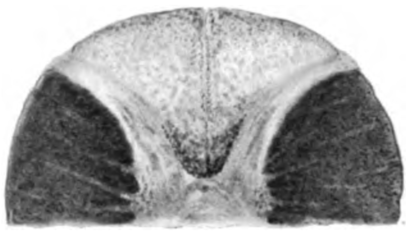


FIG. 8.

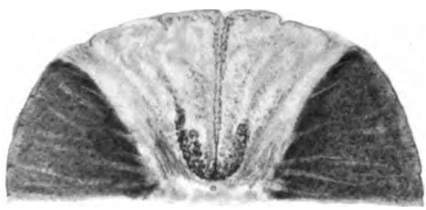
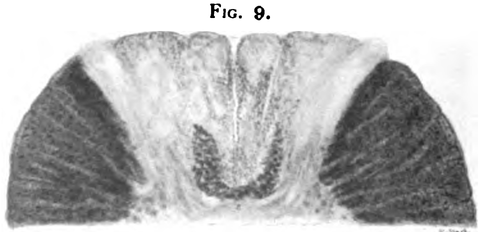


FIG. 9.



Series of sections from case of locomotor ataxia of entire cord.
Fig. 6, sacral region. Fig. 7, lumbar region. Fig. 8, dorsal region. Fig. 9, cervical region.

this cord in the cervical region (Fig. 5) shows the column of Burdach perfectly normal, and a small area of degeneration occupying the dorsal and median region of the column of Goll,—the majority of fibres in this column, however, escaping.

In the second series of figures, which I present to you from a case of my own, the lesion is much more extensive and involves the columns of Burdach and Goll in the entire extent of the cord, the sections being taken respectively from the sacral (Fig. 6), lumbar (Fig. 7), mid-dorsal (Fig. 8), and cervical regions (Fig. 9). But even in this series it will be noticed that the septo-marginal tract and the cornu-commissural tract are entirely free from a lesion. The first series of drawings, then, illustrates the lesion when the symptoms are limited to the line below the waist, while the second series illustrates a lesion when the symptoms are distributed over the entire body.

How can we explain this limitation of the lesions to certain parts of the columns of Burdach and Goll, and the escape of other portions of these columns? An answer to this question is afforded by a study of the processes of ascending degeneration in the spinal cord after a lesion of the posterior nerve-roots outside of the cord. By comparing cases in which two or three nerve-roots only on one side have been destroyed, it has been found that the ascending degeneration corresponding to the nerve-root affected varies at different levels and pursues a definite course. Thus, if you will look at the third series of drawings which I present to you, from a case kindly given me by Professor William Osler, in which a tumor had destroyed the second and third lumbar nerves upon the right side, you will see that the lesion at the second lumbar level (Fig. 10) is very extensive in the column of Burdach and corresponds exactly to the lesion seen at the lumbar level in the two cases of locomotor ataxia. At the dorsal level of this cord (Fig. 11) the area of degeneration is limited to a narrow line lying about midway between the columns of Goll and Burdach, or rather involving the border line upon both columns through the dorsal region. A section from the cervical region of this cord (Fig. 12) shows a little area of degeneration adjacent to the median septum in the column of Goll and demonstrates the exact position of the ascending fibres through the cord which comes from the second and third lumbar nerve-roots.

This is but one of a large number of cases which have been

studied recently by various authors, and by a comparison of these different cases with one another we can form a picture of the exact course of the fibres which ascend in the spinal cord from the posterior nerve-roots. In Fig. 13 I present to you a diagram which illustrates this course. On the right-hand side you see the short fibres entering in the posterior nerve-roots and terminating in the segment in which they enter. Upon the left-hand side of the diagram you see long fibres entering in the posterior nerve-roots and turning upward, to pass in the columns of Goll and Burdach up to the termination of these columns in the funiculus gracilis and funiculus cuneatus of the medulla. Each sensory nerve as it enters and turns up appears to push inward and backward those fibres which have already entered and are passing upward, and thus it is evident at the cervical level of the cord that the column of Goll is made up of fibres which have come from the sacral, lumbar, and lower dorsal regions, while the column of Burdach is made up of fibres which have come from the upper dorsal and cervical regions. This diagram shows only the shortest and the longest of the fibres which enter the posterior nerve-root. There are many other fibres intermediate in length between the short and long ones, and thus each posterior nerve-root may be said to be distributed through several segments of the spinal cord.

In both locomotor ataxia and ascending degeneration in the cord after an extraspinal lesion of the posterior nerve-roots, we find the lesion exactly limited to the track of these ascending sensory fibres. Furthermore, the character of the lesion in both cases is that of a parenchymatous degeneration of the axons and a secondary sclerotic change in the connective tissue. In fact, the present notion of sclerosis appears to be that announced by Weigert years ago,—that sclerosis is a provision of nature to give support to a portion of the cord where degeneration has occurred. Weigert says, " The neuroglia is merely a substance produced by nature to take the place of nerve-tissue which has been destroyed, and its proliferation is always a sign that the nerve-tissue has primarily disintegrated."

It is evident, therefore, from the study of pathology, that the best explanation of the limitation of the lesion in locomotor ataxia to certain portions of the posterior columns is to be found in the hypothesis that in tabes, as well as in ascending degenerations from lesions of the nerve-roots, the primary disease consists in a solution

FIG. 10.

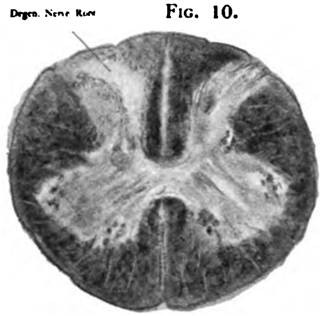


FIG. 11.

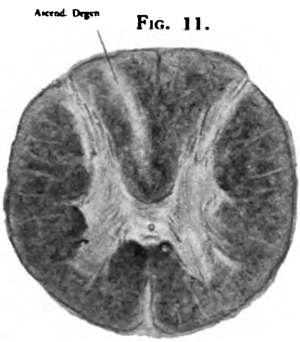


FIG. 12.

Ascending degeneration in spinal cord after lesion of second and third lumbar nerves on right side.

Fig. 10, second lumbar segment. Fig. 11, sixth dorsal segment. Fig. 12, seventh cervical segment.

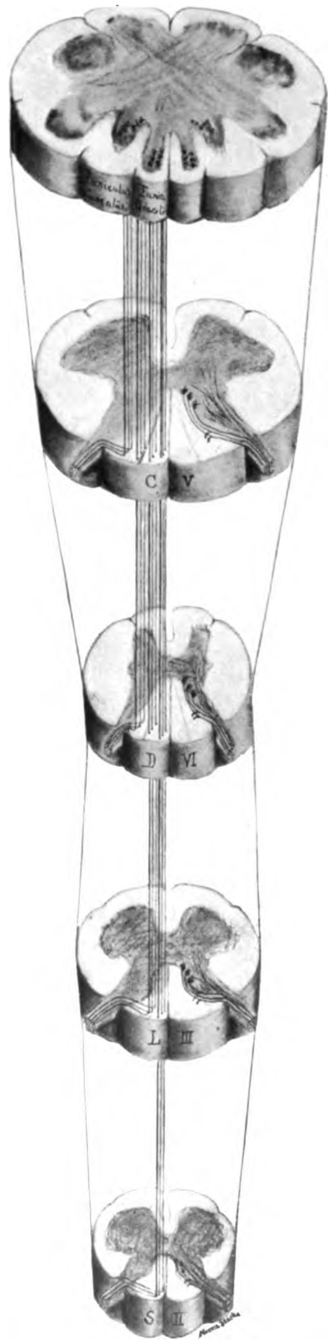


Fig. 13.—Diagram of ascending nerve-fibres in the spinal cord and of termination of sensory nerve-roots. Short fibres terminate in the gray matter and about the cells of Clarke's column. Long fibres turn upward and pass to the funiculi gracilis and cuneatus in the medulla.

of continuity in the posterior nerve-root. A sensory nerve-fibre, either at its origin in the cell-body of the neuron situated in the posterior spinal ganglion or at some point between this and its entry into the spinal cord, is destroyed. That destruction produces a further destruction in the neuron to its termination, wherever that may be, and hence there is a limitation of this destruction and degeneration to those portions of the spinal cord through which these neurons pass. The greater the number of neurons affected the greater the extent of degeneration in the cord. Thus the neuron theory explains the distribution of the lesion in locomotor ataxia, and makes it probable that the primary lesion of the disease is an affection of the posterior nerve-roots upon or at their entrance into the cord, and that locomotor ataxia is really a disease of the sensory neuron and not a primary disease of the spinal cord.

Granting, then, that locomotor ataxia is a disease of the sensory neuron, the question arises whether it begins in the cell-body in the posterior spinal ganglion or in the axon at its entrance into the spinal cord. In many cases of locomotor ataxia a distinct change has been found in the cell-bodies within the posterior ganglion, changes that have been determined by the Nissl stain and that are characteristic of degeneration and atrophy. In these cases the degeneration extends from the cell-body along the axon through the posterior nerve-root and into the spinal cord, and on to the termination of this axon at some portion of the posterior columns. There are other cases, however, in which no degeneration can be detected in the posterior nerve-root between the ganglion and the entrance to the spinal cord. The axon is destroyed within the cord, but up to its point of entry into the cord it is normal. In these cases the cell-bodies of the neuron are also often found to be normal. It seems, therefore, that there are cases where the primary lesion begins just at the point of entrance of the nerve-root into the cord. Nageotte has made a study of this subject, and he believes that there is at the point of entrance of the nerve-root into the cord a constriction, produced by the perforation of the axons through the pia mater, which he compares to that at the entrance of the optic nerve into the eyeball, and he considers that this constriction produces in many cases an interruption of continuity of the medullary sheath at this place, so that all the nerve-fibres may be said to have nodes of Ranvier at their point of perforation

through the pia mater into the spinal cord. If this view be correct, it is evident that the point of least resistance in the nutrition of the sensory neuron is at its entrance into the spinal cord, and this is the spot that seems to be attacked primarily in many cases of locomotor ataxia.

What, then, could produce a pathological lesion at this point? Anything that would interfere with the nutrition of the axon or anything which could compress it at this point. At least seventy per cent. of cases of locomotor ataxia are traceable to syphilis, the most constant lesion of which is a thickening of the blood-vessels (obliterating endarteritis), with consequent imperfect blood supply. It is well known that the distribution of the blood-vessels along the posterior portion of the spinal cord is in close proximity to the posterior nerve-roots. It has also been affirmed, by Adamkiewicz, that in syphilitic locomotor ataxia there is a thickening of the pia mater along the posterior portion of the spinal cord. We know further that there are circulating in the blood many organic and inorganic poisons which have a selective action upon the terminal filaments, the axon, or the cell-body of the sensory neuron. It seems probable, therefore, that from any one of these various agents acting upon the sensory neuron at its point of least resistance a lesion in the neuron is possible, and this would result in a condition of degeneration within the cord located in the region affected in locomotor ataxia.

What can we say of the *prognosis,* regarding this pathology as demonstrated? If the disease is one of malnutrition of the neuron with secondary degeneration, and if it is possible to arrest that malnutrition, it is evident that it is possible to arrest the progress of the disease; and this arrest occurs in very many cases under various forms of treatment and at times without treatment. There seems to be a cessation in the action of the poison and in the extension of the lesion. I do not believe that repair ever occurs, as I have never seen a case of locomotor ataxia cured. Yet this is not impossible, for we see recovery in multiple neuritis where the peripheral part of the sensory neuron is destroyed. I do believe that an arrest of the lesion is possible, for I have many cases on my records where there has been no progress whatever in the symptoms for five or ten years, and in one case for twenty-five years.

Treatment.—What shall we do to produce this arrest in the de-

generation? First, prescribe hygienic measures to build up the general nutrition. This is done by a generous diet, by moderate stimulation, by every means to promote the assimilation of food, such as country life out of doors, moderate exercises just short of the point of fatigue, general massage, and particularly by warm baths (95° to 98° F.), continued for one-half to three-quarters of an hour, the temperature being maintained in the bath, followed by rubbing, but not by shocks of cold water or by forcible douching, and also followed by a period of rest for at least one hour in the recumbent position. Many patients suffering from locomotor ataxia receive great benefit from a stay in such health resorts as Nauheim, Baden, or the Hot Springs of Virginia, because of the increased general nutrition obtained in any one of them by a regular, healthful mode of life aided by the use of baths. It is very important, therefore, to build up the general condition of the patient in such a way that he shall gain in weight and flesh. With every pound gained there will be a subsidence of the symptoms and an improved condition. When a locomotor ataxia patient begins to lose weight, trouble is in store for him. I wish to emphasize this necessity for an improved nutrition in order to warn you against advising any of the various restricted dietaries often mistakenly recommended to patients and invariably attended by an increase in their symptoms.

Secondly, prescribe tonics. As far as medicine is concerned, the most active tonic treatment should be pursued in locomotor ataxia. Every aid to food, such as cod-liver oil, iron, arsenic, quinine, is to be employed more or less constantly, and in addition a number of the newer remedies containing phosphorus, such as the glycerophosphate of soda, the glycerophosphate of lime, and the hypophosphites. These are distinctly serviceable in building up the nutrition of the neuron. I have never seen the slightest evidence of improvement from the administration of animal extracts in this disease, and I regard their hypodermic injection as useless,—in many cases harmful.

The question of antisyphilitic treatment always arises, as the suspicion of syphilis is great in all cases. If the patient has never been treated for syphilis, if his general nutrition is fairly good, if he presents any active evidence of syphilitic symptoms, or if there is a marked periodicity in the occurrence of the pains,—that is, if they are always worse towards evening and the patient is sleepless,

—a course of mercurial inunctions, accompanied by hot baths and followed by a progressively increasing dosage with iodide of potassium, is to be recommended. If the patient is anæmic and exhausted, such a course of treatment may do harm. If he has been thoroughly treated in this manner without relief, it is useless to repeat the treatment.

The chief symptoms requiring treatment are the pains, the ataxia, and the crises. Any or all of the coal-tar products may be used with marked effect in the relief of pain. A combination of them seems to be better than one alone, but individuals differ very widely in their susceptibility to these drugs, and it is a matter of experience as to which one of them will do most good in any particular case. It is well to avoid the use of morphine and codeine if possible, and to resort to them only in those extreme paroxysms of pain where the nutrition is absolutely arrested by the severity of the attack. The ataxia may be benefited by exercises now known as Fraenkel movements, in which various motions of a carefully adjusted character are practised by the patient while standing, just as he might attempt to learn a new dance, and thus a defective innervation of the feet may be corrected by voluntary effort. The only successful method of treatment for the crises is by hypodermic injections of morphine.

THE DETECTION OF LOCOMOTOR ATAXIA IN ITS EARLY STAGES.

CLINICAL LECTURE DELIVERED AT ST. LOUIS HOSPITAL.

BY ALFRED FOURNIER, M.D.,

Professor of Venereology at the Paris Faculty of Medicine.

Gentlemen,—Advanced locomotor ataxia manifests itself by such evident and characteristic signs of disordered locomotion that to speak of its differential diagnosis would be superfluous. You have only to cast a glance at the patient, either in the standing position or on attempting to walk, and your mind is made up as to the nature of the disease.

The case is, however, not the same in the early stages of the disorder. At the time when the ataxic symptoms are not yet very marked, and *a portion* during the period when they are just beginning, if you are not carefully on your guard you have a very fair chance of passing them over entirely unperceived.

At this stage the ataxia is anything but evident and does not betray itself to your eye at once. This is the period when it is latent, and when it has to be looked for to be found. I may even say that at this stage, even if you have it in mind and look for it, you may not detect it if you confine yourself to the ordinary tests, which for this purpose I think sufficient. A simple comparison will make you understand better what I mean as regards these test methods. You know some chemical reagents will detect a given substance when it exists in a compound body in large quantities, whereas they would be inadequate to bring it to light if only a small amount were present. Well, the same thing holds true with test methods.

If, in order to reveal an ataxic condition in an early stage, you were to limit your examination to the ordinary test of asking your patient to walk and then observing how he does it, there would be a strong probability of your not obtaining what you were looking for,

since at that period the disorder of locomotion may not be sufficiently evident to be certainly perceived even by a medical eye. If you wish to be sure of discovering incoördination at its beginning, you must oblige it to reveal itself by resorting to other means of investigation; in a word, you must employ more delicate reagents.

Numerous errors have come to my notice in this connection. Many a time have I seen ataxia in its early stage undetected by the physician, for no other reason than because he had been satisfied to look for it by means of tests which I again characterize as inadequate. For these reasons, gentlemen, I propose to make an effort to protect you from similar oversights, which are highly prejudicial to the patients; and, to this end, I shall endeavor to-day to do what I fear is lost sight of in your text-books,—namely, to draw up for you a line of conduct which when followed will guide you systematically and with certainty to the detection of ataxia in its early stages. I shall go into full details, and in so doing shall not be deviating from the special purpose of my lectures, as, you are quite aware, the subject is one that concerns our syphilitic patients very closely.

What, then, are the tests to be employed by you in bringing to light an ataxic condition at its very beginning? They are the following, six in number: (1) Westphal's sign. (2) Romberg's sign. (3) The staircase test. (4) The leg-crossing test. (5) Walking at the word of command, whose peculiarities can be revealed in three different ways,—at starting, at stopping, and at turning. (6) Standing on one foot, (*a*) with open eyes; (*b*) with eyes closed.

1. *Westphal's Sign.*—I need not say much concerning Westphal's sign, to which I often call your attention. It consists in the total absence of knee-jerk in the patient, and is met with in quite two cases out of three in the pre-ataxic period. The sign is well known.

2. *Romberg's Sign.*—This is how you must interpret Romberg's sign. The eye is in a certain way an indirect regulator of movement, a supplementary agent which to some extent helps out defective muscular coördination, maintains the equilibrium, corrects errors of movement, and keeps up an apparently normal mode of progression during the first stages of the disease. In clinical medicine we have taken advantage of this fact to supply ourselves with an additional diagnostic test for ataxia, by doing away with sight

temporarily and ascertaining what the muscular system can still accomplish when deprived of this ally.

The test is very simple. You merely request your patient to stand up straight in the position of a soldier under arms and with both eyes closed. What happens then is this. In a few moments he begins to oscillate, bending forward or backward, to the right and to the left. This is enough to show you that even while standing up straight he is in a condition of unstable equilibrium as soon as his sight is no longer there to rectify the mistakes of his muscular system.

You must not, however, expect to find at the very beginning of this disease, which is the period we are now considering, the wide oscillations and tottering, with complete loss of equilibrium and risk of falling, that the same test gives rise to in confirmed ataxia. Far from it; you must understand that all you will detect will be a rudimentary form of these symptoms, and in the majority of cases you will notice nothing more than a slight balancing motion of the body not exceeding a few degrees in limit, in fact in some cases almost imperceptible to any but an attentive and experienced eye.

Another point on which you must be forewarned is that the unsteadiness in equilibrium will not always occur as soon as the eyes are closed. You will in some cases have to wait one, two, or three minutes before observing it.

When there is no doubt as to the presence of this sign of muscular uncertainty occasioned by closing the eyes, it is an excellent symptom of locomotor ataxia. Look for it always with great care, particularly as in some instances it is the first phenomenon that will give you any definite clue to disordered locomotion in your patient. This happened to me only a short time ago in a case that was brought to my notice; and this is not the first time, by any means, in which Romberg's sign has put me on the track of an ataxic condition that had not yet been detected.

3. *The Staircase Test.*—One of the earliest and most frequent signs of ataxia at its beginning is the difficulty these patients experience in going downstairs. Note that I say *downstairs.* This is easy to understand, as the act of going down a set of steps is a difficult, complex, and risky one, which demands complete integrity of the faculties for coördinating movement. It is rational to assume that this exercise will be likely, more than many others, to reveal

the commencement of trouble in the muscular system. And so you will find it. All your ataxic patients will tell you, but, unfortunately, almost always in a retrospective way,—that is, at a period when the diagnosis no longer requires this symptom,—that so far back as the very beginning of their trouble they noticed a peculiar difficulty or even actual apprehension while going downstairs; that they could only go down slowly, with precaution, holding on to the balusters. They were afraid of falling; they often stumbled, and would have fallen but for the precaution of holding fast to something.

You should, therefore, take advantage of your knowledge of this fact in trying to form a diagnosis at an early stage. Never fail, when you suspect ataxia, to question your patient on this point, particularly as this is a symptom that cannot escape their notice and concerning which they can always give you reliable information.

4. *The Leg-crossing Test.*—An ataxic patient who sits down and crosses his legs does not execute this movement in the same fashion as a man whose muscular system is in a normal state; he does it in a pathological manner, that is an exaggeration of what the normal man does and that betrays his condition in a way that I shall attempt to describe to you.

When a man in a normal state, seated, wishes to cross his legs to take the attitude of rest, he simply raises one leg to the necessary height and passes it across the other knee.

The ataxic patient, on the other hand, not only raises his leg higher than necessary, but also throws it forward in an exaggerated way, so that the crossing of his legs is effected by his passing his entire leg through a segment of a circle of unnecessary amplitude. The extent of this movement is manifestly greater than it ought to be, and what the patient intended it to be, and this lack of harmony between will and execution is revealed to you by the uncalled-for action of the leg.

This may seem to you a small matter, and yet it is an error of movement that will at once strike an observing person and particularly an observer who is forewarned and on the lookout. To prove this I can tell you that on several occasions I have been at once led to suspect ataxia in a patient entirely unknown to me, merely from the way in which he seated himself and crossed his legs before beginning his story. There is in this exaggerated and useless pro-

jection of the leg a movement so unusual as to be quite peculiar and striking. No man in a normal condition would ever make such a badly calculated movement, unless he did so on purpose. It is clearly a pathological act conveying a special signification, which is no other than the idea ataxia.

5. *Walking at the Word of Command.*—Under this heading I shall unite three different tests for ataxia that are highly suited to reveal the beginning of locomotor defects of coördination.

The first is this: Your patient being seated, ask him to get up and to begin to walk as soon as he is up. A man who is in entire possession of his motor faculties will execute this complex movement in a steady and precise manner, that you all are familiar with and that it is unnecessary to describe.

An ataxic patient, on the contrary, even if only at the beginning, will betray his disease by one or the other of the following peculiarities. Either when he is on his feet he will show a certain hesitation in stepping out and walking off at once,—that is, he will feel the need of finding his equilibrium, of steadying himself before starting, and there will be a pause of a moment or more between the time when he is really on his feet and when he begins to walk; or, when he has taken the vertical position, he will oscillate a little and will add to the necessary movements an accessory one, indispensable for him but useless for a normal person, by means of which he will get his balance before he starts. In short, in one or the other of these ways, and in different degrees, you will notice in his action something superfluous, and, however trifling it may be, it will reveal a shortcoming in the muscular system, a suspicion of incoördination.

The second test of this group is elicited by asking your patient when walking to stop short at a signal given by you.

A man in a normal state, when told to stop short on command while walking, does so correctly, without hesitation or loss of balance, without uncertain or unsteady movements, and particularly without addition of superfluous movements. An example of this is the way a battalion of soldiers stops short on command.

But this is not the way an ataxic patient does it. When told to halt, he tries to do so, but has no longer the power to moderate his acquired momentum. Then he either has to bend his body forward as though bowing, and even in some instances only saves himself from falling by throwing forward one foot, or he throws himself

backward to counteract the momentum that tends to carry him onward. Thus in one way or another an ataxic patient stops with hesitation, oscillation, supplementary movements, or in some unusual attitude, which at once reveal to a trained eye a lack of control over voluntary movements,—that is, incoördination.

In the third test of this set the patient is to turn quickly around while walking away from you and to begin walking towards you at once, at your word of command.

In this difficult and complex movement, which requires the action of a number of groups of muscles, the ataxic patient, instead of turning accurately round, shows visible signs of distress; either a halt, an uncertain gesture, an unnecessary movement, or a loss of equilibrium, with possible risk of falling, betrays the deficiency of muscular control that you are looking for.

I do not claim that these tests are infallible, or that by their means you will in all cases detect the incoördination; but what my experience enables me to say in that as delicate reagents for incoördination they are far more reliable than the usual method of examining the voluntary power of walking, and this because they require the muscles to make sudden and unexpected movements which are better calculated to bring to light the beginning of an ataxic condition than the voluntary, foreseen, and almost automatic movements of ordinary locomotion.

6. *The Standing on One Foot Test.*—This is, so far as I can see, the most effective test for detecting incoördination at the start. It consists in asking your patient to balance himself on one leg, raising the other foot completely from the ground, first with eyes open, then with them shut. This is not an attitude to which we may be said to be accustomed; yet any of us ought to be able to assume it and to keep our equilibrium in it for a few moments, at any rate, if we have entire control over our muscular system.

But observe what happens to an ataxic patient whose muscular system has begun to be affected when you ask him to do it. This patient is already none too successful in keeping his balance with two legs to stand on, so that when one of these props is removed the other will be less able to take the place of its partner, because it is in a pathological condition. So a patient who is at the beginning of the ataxic state will have the greatest difficulty in accomplishing this feat; he no sooner tries to throw his weight on one leg than he sways

in every direction, and would soon fall if he did not put the other foot to the ground at every moment in his anxiety to keep his equilibrium.

This test is a curious one, and a decisive one in many cases. It is curious in that in some instances it is sufficient to reveal instantly a muscular disorder that may have eluded many other modes of examination and of which the patients themselves are not at all aware.

It is also often decisive because of the clearness and precision of its results. The patient no sooner raises one foot from the ground than the total loss of balance becomes so perfectly manifest as not to leave the slightest doubt as to the incoördination.

For a still more delicate test you ask the patient to close his eyes and then try to stand on one foot.

This test unites in one all the possible difficulties in effecting coördination of movement. It deprives the body of one of its bases of support and also of its indirect regulator of movement. We have already seen that even with open eyes a patient in the early stage of ataxia has the greatest difficulty in standing on one leg; if then his last help, his sight, be taken away, you can imagine what his power of keeping his balance is reduced to. And, naturally, the greater the difficulty in the way of coördination the more likelihood that a muscular system which is beginning to be disordered will betray this condition by defective action.

With your patient, then, in this position, on one foot with eyes closed, if the ataxic condition is even at its very start it will infallibly be revealed to you. The patient begins at once to totter and fall; in many cases he cannot retain the attitude for even a second, and it is prudent when making this experiment to have an attendant close at hand to prevent the patient from falling to the ground.

This is a most severe test, as I have already remarked. In more than one instance where negative results had been given by all other tests, even that of standing on one foot with open eyes, the ordeal with closed eyes has betrayed a beginning of ataxia. This is not very surprising, as it would be difficult to imagine a more trying position in which to place a person whose control over his muscles is impaired.

Such, gentlemen, are the six clinical tests that you can use to detect locomotor ataxia at the beginning, before any of its symptoms are manifest and before the patient has any suspicion that

there is any such trouble. The use of these tests is indispensable if you wish to accomplish this purpose, as the ordinary routine way of simply inspecting the patient's method of walking is quite inadequate in the early period of ataxia, and will be certain to lead you to gross oversights with their consequent annoyances.

The tests that I have just described are evidently not all of equal value, but I do not think it worth while to discuss their individual merits. The only safe way for you is not to neglect any of them, but to make it your business to use them all systematically, so as not to let any case, no matter how early in the disease or how undeveloped the symptoms, escape your examination. In such a serious disorder as this no trouble should be spared in endeavoring to make a definite diagnosis at as early a moment as possible, and no pains should be deemed too great to obtain this desideratum.

Surgery

LITHOLAPAXY; OSTEOMYELITIS; TUBERCULOUS TESTICLE; HYDROCELE; MYXO-SARCOMA OF ARM; INGUINAL HERNIA; EXCISION OF THE UPPER MAXILLA; UNUNITED FRACTURE OF FEMUR; COMPLETE RECTAL FISTULA; FOREIGN BODY IN THE NECK.[1]

ABSTRACTS FROM THE PUBLIC SATURDAY CLINICAL LECTURES DELIVERED AT THE GERMAN HOSPITAL.

BY JOHN B. DEAVER, M.D.,
Surgeon-in-Chief to the German Hospital, Philadelphia.

LITHOLAPAXY.

C. B., male, white, aged forty-seven years.—Vesical calculus is a condition for which much ill-advised surgery is done. Suprapubic cystotomy is the common operation; but litholapaxy is the artistic method, and the one to be preferred. This is the older operation, which a few years ago was done rapidly and skilfully by the surgeons of the day on carefully selected cases. The contra-indications of litholapaxy are severe cystitis, a contracted bladder, a large prostate, a large and hard stone, and Bright's disease. In cystitis drainage is needed. In Bright's disease the traumatism due to crushing seems, reflexly through the hypogastric plexus, to influence unfavorably the kidney lesion, and may precipitate uræmia. On a patient with chronic Bright's disease with granular and hyaline casts having a large stone which would require considerable time to crush, suprapubic cystotomy should be performed. Dr.

[1] From reports by Drs. Godfrey, Ellis, and Cooley. Edited by Drs. A. D. Whitting and A. O. J. Kelly.

Keyes, who has great skill in litholapaxy, finds no contra-indication in the character of the stone. However, a large stone is often an indication for the suprapubic operation. A contracted bladder should be entered by the perineal incision, either lateral or median.

Operation.—Ether anæsthesia, followed by oxygen. The patient was in the recumbent position, the thighs being slightly separated. A stone-searcher was oiled and passed into the bladder. The stone was found; and a sounding-board was attached to the sound to demonstrate the click of the contact. A soft-rubber catheter was introduced and the urine drawn. The urine was clear, there being no cystitis. Four ounces of boric acid solution were forced into the bladder through the catheter by a piston syringe, and a portion was withdrawn. The catheter was removed. A Bigelow lithotrite (No. 27, French) was oiled and passed into the bladder. The stone was caught between the opened blades, and was carried gently to the centre of the bladder. The instrument turned freely, demonstrating that the vesical mucosa was not caught. The stone was crushed by light pressure, and the larger fragments were crushed in the same manner. The lithotrite was closed and withdrawn. An evacuating tube, with the stopcock adjustment in place, was oiled and introduced, and the Bigelow evacuator was attached to the external end. By gentle pressure of the elastic bulb the fragments were withdrawn from the bladder and dropped into the glass bulb of the evacuator. There was little blood. The evacuator was emptied, refilled, and applied again. The tube was withdrawn. The smaller Bigelow lithotrite was then oiled and introduced. The blades were opened, and the instrument was gently revolved until a fragment of the stone rolled within the blades, which were locked upon it. The lithotrite was brought to the centre of the bladder and the fragment was broken. The blades were closed and the lithotrite withdrawn. A larger evacuating tube was introduced with the stopcock applied, and the evacuator was adjusted. A fragment could be felt impinging against the edge of the tube, which was too small to admit it. The lithotrite was again passed. The small fragment eluded the tool. The blades were closed and the instrument withdrawn, and a larger evacuating tube was introduced with a stopcock attached. The sound was introduced; no fragments were discovered. A soft-rubber catheter was passed and the fluid withdrawn. With a glass

piston syringe a boric acid irrigating fluid was injected into the bladder through the catheter, and was then evacuated.

The patient made an uninterrupted recovery and was discharged on the eleventh day.

SIMPLE OSTEOMYELITIS OF THE RIGHT TIBIA.

C. S., male, white, aged twenty-two years.—The patient was admitted with a history of having hurt his leg when a child. Six years ago he again injured it, and since that time has suffered, more or less, constantly. The pain has always been more severe at night. The diagnosis is Brode's abscess; a circumscribed abscess of the head of the tibia. This is a simple or circumscribed osteomyelitis, in distinction to the diffused and gangrenous forms. The process begins as a localized periostitis with associated osteitis. Traumatism in a scrofulous or tubercular subject precipitates the chronic inflammation. There is a sinus on the inner side of the right knee leading down to the abscess cavity within the tibia. This will be opened and the walls of the cavity will be gouged and chiselled away. With good drainage repair will soon follow. Transplantation of bone or the use of decalcified bone chips might be resorted to to further the reparative process, but these methods are uncertain.

Operation.—Ether anæsthesia. The patient was in the horizontal position. An Esmarch bandage was applied to the right foot and leg and was carried above the knee. The Esmarch rubber band was fixed about the thigh in this situation and the bandage was removed. Incision was made through the sinus, which was opened down to the bone. The walls of the sinus were curetted. The bony walls of the cavity were cut away with a chisel and wooden mallet. The floor was gouged away and the walls were scraped with a bone curette. The cavity was washed and packed with iodoform gauze. Dressings of dry gauze were applied and covered with a roller bandage reaching from the toes above the knee. The rubber band was removed. The patient was transferred to the Out-patient Department on the seventh day, with a healthy granulating wound.

Abscesses of bone in this region are especially dangerous in the young. Extension into the knee-joint, osteoarthritis, and diffuse gangrenous osteomyelitis from perforation or separation of the epiphysis may follow.

EXCISION OF A TUBERCULOUS RIGHT TESTICLE AND LEFT VASECTOMY FOR HYPERTROPHIED PROSTATE.

M. A., male, white.—This patient suffers from an enlarged prostate, and has a diseased and degenerated right testicle, resulting from tubercular epididymitis. The epididymis was probably the site of a tubercular abscess which has ruptured externally. The skin of the scrotum is adherent, irregular, and indurated, and contains the mouths of sinuses. The function of the testicle is doubtless abolished. The prostate is uniformly enlarged, and is of the spongy, in contradistinction to the cicatricial, variety. The symptoms of hypertrophy of the prostate are marked: frequent micturition, especially at night; cystitis with residual urine. The urine also contains pus and albumin.

Equally conservative surgery should rule in the treatment of the male and female generative organs. Some surgeons, for the reason that the male retains the power of fecundation later in life than the female, would advise the removal of the tubercular epididymis only. This is not a wise procedure in the case of a tubercular lesion. It is far better to remove the testicle and its appendages than to assume that the process is limited to a single portion of the organ. This variety of hypertrophied prostate is that in which double castration has shown a certain percentage of cures.

The operation in this case will consist in an excision of the diseased right testicle and a left-sided vasectomy.

Operation.—Ether anæsthesia, followed by oxygen. The patient was in the horizontal position. The left spermatic cord was grasped with the left hand and the vas deferens was located beneath the finger. The overlying skin was incised; the edges were retracted; the vas was freed from the cord and a hæmostatic forceps was passed beneath it. It was ligated with catgut in two places and the included portion was excised (one-half inch). The wound was closed with interrupted sutures of catgut and was sealed with iodoform collodion. Incision was then made over the right cord, which was enucleated by the finger. It was transfixed and tied off in four sections by catgut and cut through by scissors. The incision was prolonged down over the testicle, which was enucleated and removed together with the overlying indurated and adherent skin. The vessels were tied and the wound was washed.

A drainage-tube was inserted in the lower end of the wound, which was closed by interrupted sutures of silkworm gut. Gauze and cotton dressings and a perineal bandage were applied.

Macroscopic examination showed the specimen to consist of a testicle eight and five-tenths centimetres in length, five centimetres in width, and four and five-tenths centimetres in thickness. The gland itself was of normal consistence except in the centre, where there was an area of caseation about two centimetres in diameter. The organ was surrounded by a tough, indurated mass of hyperplastic connective tissue. Microscopic examination revealed the well-known lesions of tuberculosis,—epitheloidal cells, round-cell infiltration, giant cells, and caseation. The mass of indurated connective tissue was the seat of considerable round-cell infiltration.

Prostatic hypertrophy may be general, and the organ hard and cicatricial or spongy in consistence, or it may be circumscribed, involving one or both lateral lobes, the median lobe or the muscular fibres of the prostate encircling the prostatic urethra. The hypertrophied median lobe projects backward and occludes the orifice of the urethra by a ball-valve action. The muscular fibres between the orifices of the ureters become hypertrophied, constituting the interureteral bar. The thickened muscular walls of the prostatic urethra form a firm collar, the "horse-collar prostate."

The *extra-vesical operations,* castration and vasectomy, are applicable only to the condition of general enlargement, which is of spongy consistence. In the other forms of hypertrophy they are useless. Vasectomy may be done under cocaine anæsthesia, which simplifies the procedure in the old and debilitated.

Prostatectomy by suprapubic incision and intravesical enucleation of the hard prostatic mass is the ideal method. It is comparable to the operation of myomectomy for subserous uterine myomata. Frequently so complete an enucleation can be accomplished that it is possible to restore the level of the prostatic urethra to the level of the floor of the bladder. If no vesical atony exists, or only moderate atony which is amenable to treatment, the normal condition of the bladder can be restored.

Circumscribed hypertrophy of the median lobe may be treated by suprapubic prostatectomy or galvano-caustic incision with Bottini's prostatic incisor. The suprapubic operation may be followed

by complete and brilliant results. Such a case was operated upon here during the summer in which, prior to operation, catheterization was most difficult. By suprapubic incision the bladder was opened; the vesical mucosa was divided by scissors; the median lobe was gouged and curetted away until a sound passed through the urethra by its own weight; and the vesical mucosa was sutured. The patient is now perfectly well. Bottini's method is applicable to a limited number of cases. It has done much harm under conditions in which it was contra-indicated.

Bottini's prostatic incisor, as now modified, is in appearance similar to a lithotrite. It consists of a male and a female arm, the beak of which is short and forms almost a right-angle with the shank. The shank of the female arm contains a platinum knife, which leaves a groove in its under surface on turning a wheel at the lower end of the instrument. A device for cooling traverses the entire shank and the beak. Scales in millimetres record the distance through which the knife has cut. The handle is broad; and the electric current is conducted through insulated wire in the centre of the shank. The instrument is introduced through the urethra, and is then inverted, the beak of the instrument fitting the enlarged lobe. This portion of the gland is then cut through with the knife at a white heat. The instrument is slightly turned and one or more similar channels are cut. Ice water is at this time flowing from tubes in the shank of the female arm. Cystitis is a contra-indication to this operation. Drainage is often interfered with as a result of the local inflammatory condition following the operation. A catheter should be allowed to remain in the urethra under these circumstances; and the bladder should be irrigated twice daily with a weak solution of potassium permanganate. Relapses may occur.

Each case of prostatic hypertrophy is a law unto itself, as is each case of vesical calculus. Hence each case must be studied carefully to decide whether it is operable or not. Examine first the urine chemically and microscopically. If catheterization must be resorted to, try to avert the disastrous results of the use of a non-sterile instrument.

Castration was formerly regarded as a most formidable operation. An écraseur was used. An assistant with a finger upon the pulse noted the violence of its disturbance when the section was

complete. A long silk loop was brought out through the wound, so that in case of consecutive or secondary bleeding the cord could be pulled down into the wound. Ligation of the cord low down is of advantage. It will not then retract into the inguinal canal, and this region should not be trespassed upon for any post-operative condition. The cord should be ligated in sections.

EXCISION OF THE SAC OF A HYDROCELE.

J. D., male, white, aged twenty-five.—A large translucent swelling is seen occupying the lower portion of the left scrotal sac.

Hydrocele is a common affection; pathologically, it is a form of retention cyst. It is most frequently met in the laboring classes. In the majority of cases it can be attributed to strain or violent muscular effort. There are several operations applicable to this condition, and surgeons differ as to their comparative merits.

The old method of treatment by injection of tincture of iodine into the sac is attended with great disadvantage. Orchitis or epididymitis is frequently caused by the violent irritation. These very disagreeable complications make convalescence tedious and protracted. It is the most painful method of treatment, even when done under ether. Again, if the sac is multilocular the treatment is futile.

The open radical operation is attended with the best results. It is more rational and more certain. Two methods of open operation are equally good. The sac is exposed, dissected free, opened, and the excessive parietal tunic is cut away. The testicle is then dropped back; a drainage-tube is inserted and the external wound sutured. Another excellent method, which is perhaps more frequently employed, is as follows: the sac is opened, dried, wiped out with pure carbolic acid, and packed with iodoform gauze. The margins of the tunic are sutured to the skin wound. The first method is attended with results equally good and permanent; and the scar is much less marked.

Operation.—Ether anæsthesia, followed by oxygen inhalations. The patient was in the recumbent position. Incision was carefully made in the skin over the sac, which was freely opened. The testicle was exposed. The parietal tunic was cut off on both sides by scissors, the epididymis on the inner side being carefully avoided. The vessels were tied, a rubber drainage-tube was inserted, and the

external wound was sutured by silkworm gut. Dry dressings of gauze and cotton were applied and fixed by a perineal bandage.

The drainage-tube was removed on the third day and the stitches on the sixth. Patient was discharged on the fourteenth day.

OPEN OPERATION FOR VARICOCELE.

L., male, white.—The left cord was grasped and the vas deferens located on the inner side of the cord. Incision was made over the cord, the skin retracted, the fasciæ and tunica vaginalis were divided and a section of the veins beneath which catgut ligatures were placed removed. The catgut ligatures were tied about one inch apart. The section of veins intervening was excised. The ends of the stumps were brought together and the sutures tied. The wound was closed without drainage by interrupted silkworm-gut sutures. Dry gauze dressings and a scrotal bandage were applied.

NON-OPERABLE CASE OF MYXO-SARCOMA OF THE ARM.

A. S., female, white, aged nineteen years.—We had expected to remove the entire upper extremity of this patient, or at least do a shoulder-joint amputation; but at the last moment we have decided against operative interference. We have been uncertain as to what we could best do, and have studied the question most carefully. The surgeon becomes more conservative as his experience grows larger, although he does not always enjoy the reputation of being painstaking and conscientious in his study of cases. The patient was admitted ten days ago. We refused operation four days ago, suggesting as the procedure the removal of the entire left upper extremity. We desired the family to remove the patient from the hospital. The advice of a physician who was popularly reputed to cure such conditions was sought by the family, and we invited the practitioner to treat the patient here; his methods were useless, as we anticipated. The family then requested that we allow the girl to remain in the hospital.

What, then, is to be done? The removal of the upper extremity, regarded by the student as a formidable operation, is thoroughly simple after the ligation of the subclavian vessels. The difficulty is from the patient's standpoint, first, as to diagnosis; secondly, as to what must be done to eradicate the condition; thirdly, as to what can be done with fullest advantage to the patient.

There is a family history of tuberculosis on the maternal side. The patient had typhoid fever at the age of fourteen; appendicitis at sixteen, for which operation was done here; her health since has been good. Menstruation began at thirteen years; it has been irregular, two to four weeks, of two days' duration, and scanty. For six months prior to the operation for appendicitis there was amenorrhœa; reëstablishment of the flow followed operation, which suggests that the appendicitis had been the cause of the disturbed function. There has been pain in the left ovarian region.

The present trouble began five weeks ago; for three weeks there had been pain in the left arm between the shoulder and elbow; no swelling was noted at this time. Two weeks ago a small lump was seen on the upper third of the arm, which has since become larger; its borders when first seen were red and inflamed, but this areola has now faded. The pain was excruciating, requiring large doses of anodynes for its relief. The temperature was negative (97°, 98.2°, and 99.8° F.). There is no history of accident or injury. On palpation of the growth, we instantly suspected some form of malignant disease; on second consideration the diagnosis was narrowed down to sarcoma and deep-seated abscess. The family history, the menstrual history, the fact that the growth was not connected with the humerus, but apparently sprang through the biceps muscle, the mode of onset without history of injury, favored the latter condition. The temperature was negative, and is not of importance from a diagnostic stand-point, since we have charts which present the same characteristics in sarcoma as in abscess. x-ray examination indicated that the mass was not connected with the humerus, and osteosarcoma was thus apparently excluded. A portion of the mass was excised and prepared for microscopical study by the rapid method. The growth was found to be a myxosarcoma, made up of large and small round cells with some bone formation.

The condition, situated close to the shoulder, in a girl of nineteen years, whose constitution is impaired in other respects, is then the most fatal form of malignant disease. It is a great misfortune for a young girl to lose an arm; and with the prospect of certain, early recurrence, it is perhaps better that this sacrifice to the malignant condition should not be made. However, another complication came to light. The violent pain in the arm had disappeared, but

the patient complained at this time of a slight pain in the left upper chest anteriorly and posteriorly. Physical examination demonstrated signs of consolidation. Examination with the fluoroscope by the x-rays shows an opaque area, anteriorly in the upper third of the chest, which does not move with the lung expansion. A posterior view could not be obtained.

We would now say positively that operation is out of the question. In the presence of this condition within the chest surgical intervention would be futile. You may ask why a tuberculous consolidation of the lung, which may perhaps become encapsulated and cured, should contra-indicate surgical procedure in so urgent a condition. The consolidation is not tubercular, as is shown by the fact that the patient has been well, barring her menstrual history, until five weeks ago, and that no symptoms have been referred to the chest except slight pain at this time. Myxo-sarcoma is present in the lung as a metastasis, and multiple foci will in all probability develop in other parts of the body. We are convinced that a non-operative course is the best to pursue.

The clinical importance of this case to you is greater by far than many in which operation is indicated. It illustrates conditions that will present themselves to you in practice, and the importance of diagnostic care and skill. The use of the x-rays and the microscope tends to supplant in the minds of students the personal factor in diagnosis. Yet we must, one and all, depend largely on personal skill in reaching correct conclusions.

To revert to our case of LITHOLAPAXY, I should have said that the *subsequent treatment* will consist in rest in bed, the application of warm flaxseed poultices above the hypogastrium, the administration of quinine in five-grain doses twice daily (by the mouth or in suppository), and the use of opium if there are pain and much irritability. The diet will be light, and lithia water will be freely given. After the patient has recovered from the effects of the ether a catheter will not be used unless necessary. *Three or four ounces of fluid* should be within the bladder during litholapaxy. Injury to the vesical mucosa can be avoided by rotating the lithotrite and carrying the stone towards the centre of the bladder before applying the crushing force.

The *average length of time* for the operation is twenty minutes.

One hour is not too long in a patient with healthy kidneys. The great advantage over all other operations is that the patient will be able to return home in a few days. The only objection, in the absence of the recognized contra-indications to this operation, is that a small fragment being left behind may become the nucleus of another calculus.

MODIFIED BASSINI OPERATION FOR INDIRECT INGUINAL HERNIA.

J. N., male, white, aged thirty-six years.—Operations for the radical cure of hernia cannot be seen too often by the student. The abundant opportunities through which the student of to-day may become familiar with the details of these common surgical procedures are not appreciated to their full value. Those who have access to the dissecting-room should acquaint themselves with the steps of the operation. Familiarity with anatomy is an essential factor in a surgeon's success. There is no operation which may be done with greater success or with more complete failure than that for the cure of hernia.

A hernia is the protrusion of a viscus or a portion of a viscus into or through the wall of its containing cavity. Any viscus may form part of a hernia. The common sites of herniæ are in relation with the femoral and inguinal canals and the region of the umbilicus. Inguinal hernia is common in the male but less so in the female. Femoral hernia is of common occurrence in females in early and in late life. Umbilical hernia is frequent in the middle period of life in females as a result of the relaxation due to frequent child-bearing and of the accumulation of fat in the mesentery. Labial hernia is a complete indirect inguinal hernia in the female. A pudendal hernia emerges by way of the outlet of the pelvis. It results from rupture of the levator ani muscle or its enveloping fasciæ anteriorly, and presents at the side of the vagina. Strangulation of the bowel may result during labor if the hernia is not recognized and reduced; if strangulation occur, abdominal operation must be done to relieve it. The differentiation of these last conditions is troublesome to the student. An incomplete inguinal hernia which is irreducible, presents great difficulties in differentiation from a femoral hernia. The direction of the hernia is downward, forward, and upward. If reducible, its nature is apparent; if not, it might be femoral or inguinal. If irreducible and made up of

omentum, it cannot always be differentiated from a bubo. Hence in the presence of an irregular swelling in the groin which transmits no impulse on coughing be guarded in your opinion. Diagnosis under such circumstances cannot always be correct. However, with swelling in the groin and associated symptoms of acute indigestion—pain, nausea, and vomiting—without localizing rigidity and tenderness to indicate a focus of infection, cut down on the mass in the groin. It may be a mass of inflammatory matter or a strangulated hernia. The attachment of the mesentery is a definite etiological factor. The majority of herniæ occur on the right side. The line of mesenteric attachment extends from the left side of the second lumbar vertebra to the right sacro-iliac synchrondrosis. A deposit of fat within the folds of the mesentery tends to lengthen it. One method of radical cure takes cognizance of the relation of the mesentery to the condition and attempts to provide against recurrence by shortening the mesentery; this, however, I advise against.

The *relations of the cord* are the same after operation as before. In Halsted's operation the origin of the arching fibres of the internal oblique muscle in addition to the aponeuroses of the external oblique are divided; they are reunited with mattress sutures; the cord is placed without the aponeurosis of the external oblique muscle, its one cell of veins having been excised. The canal is thus made more oblique, and a greater barrier to the descent of the hernia is established. The weak points of this operation are the division of the fibres of the internal oblique muscle, and the disposition of the cord.

Macewen's method of disposing of the sac is the one that we employ.

Congenital hernia is that form which depends upon defective closure of the vaginal process of the peritoneum which enveloped the cord and testicle in their descent. This in the young is often benefited by the application of a truss. Radical treatment is not as certain in the congenital variety of hernia as in other forms of hernia. After cutting down on the sac the sac is divided by a circular incision and sutured. Thus a tunica vaginalis is preserved. The upper or approximal portion of the sac is incised posteriorly, separated from the cord and vas, ligated high up, and treated as in the other forms of hernia.

There are several varieties of congenital hernia, as follows:

1. The vaginal, in which the vaginal process being in communication with the peritoneal cavity the sac descends about the testicle and cord. 2. The funicular, in which the process has closed over the testicle, but has remained patent above. The hernia is in relation with the cord. Diverticula of the hernial sac may be formed, which are very complex. 3. The infantile or encysted, in which the tunica vaginalis is closed in the inguinal canal. The descending hernia may invaginate the diaphragm, and the sac is formed within the sac; or the hernial sac may be carried behind the closed tunica vaginalis.

Methods.—The vessels of the superficial fascia must be tied, a compress being insufficient. It is better to tie them early, and thus have the wound free. A spell of coughing on the part of the patient after the anchoring of the sac demonstrated how effectually that device shut off the internal ring. The lowermost suture through the tendon of the rectus muscle, the triangular ligament of the abdominal walls, the conjoined tendon, the transversalis fascia, and the shelving margin of Poupart's ligament must be very carefully passed to include well all these structures and avoid the spermatic cord.

The *superficial fascia* is of especial surgical importance in the region of the groin. Two layers are separable, between which lie the inguinal glands. The superficial layer is continuous with the fascia of the thigh; the deep layer is blended with Poupart's ligament, but is in communication with the scrotum by a small channel over the pubes, the scoto-abdominal passage-way. This is the explanation of the course which extravasated urine takes in rupture of the urethra anterior to the triangular ligament. In conditions of emphysema of the trunk, if the air is beneath the deep layer, the tissues of the thigh are not affected; if between the two layers of the superficial fascia, the thigh also is involved.

Incipient inguinal hernia and chronic appendicitis present at times a similar train of symptoms and must be differentiated by physical examination.

Rubber gloves are now an important part of aseptic technique; and in no class of cases are their good results better demonstrated than in hernia. Infection renders the last condition worse than the first. Since using rubber gloves there has been no infection after a hernial operation in the German Hospital.

A patient with a hernia of long duration which has been often temporarily irreducible can often reduce it better than a doctor, having learned the particular direction in which to manipulate. Temporary irreducibility results from the presence of gas or fecal masses within the coil of bowel contained in the sac. Under these circumstances, and under these only, is the administration of a purgative warranted. There are, however, no direct means of establishing the diagnosis of such a condition. Permanent irreducibility is present under two conditions: strangulation, or the existence of adhesions between the contents and the wall of the sac.

Strangulated hernia is a condition in which, by a constriction within the sac or at its neck, the blood and fecal currents in a loop of bowel are arrested.

The treatment of suspected or real strangulated hernia should be as follows: the patient should be placed in bed with the thighs flexed on the abdomen, to relax the outlet of the inguinal or femoral canal; the administration of a high enema; an ice-bag locally; opium in judicious doses to control pain. These may suffice to reduce the hernia. If not, the first sign of nausea indicates operation for the relief of the obstruction if reduction under the anæsthesia is not possible.

Opium is the drug for all cases of intestinal obstruction in the absence of operation; yet croton oil is often given. This last is a drug which is useful in medicine only as a counter-irritant, and should never under any circumstances be given internally. Its use in apoplexy cannot compare with the results of bleeding. Any purgative in the presence of intestinal obstruction violently aggravates the condition, and its use is unjustifiable.

Chronic bronchitis and emphysema do not contra-indicate operation in this case. Such chronic pulmonary conditions need not delay operation. Careful administration of the ether may result in beneficial stimulation of the bronchial tubes with considerable immediate relief. Acute pulmonary inflammations, on the contrary, forbid operation except in cases of strangulation. A fatal pneumonia might result, and thus it is necessary to accept the less of two evils.

Every hospital surgeon has a percentage of deaths each year from strangulated hernia. One class of cases is admitted moribund, and in another the strangulated gut is gangrenous. The

percentage of deaths would be at a minimum if the course of treatment which has been outlined were carried out.

The *dressings* will not be removed for eight or ten days, when the skin stitches will be taken out. The second dressing will remain until the third week, when the patient will sit up. Some surgeons have applied a plaster-of-Paris bandage to the thigh and abdomen after these operations. It is more uncomfortable to the patient, and the results from a properly applied roller bandage are equally good.

The *relation of the deep epigastric artery* will at operation indicate whether a hernia is direct or indirect. Indirect inguinal hernia, the most common form, enters the canal at the internal ring. In old herniæ, in which the walls are subjected to considerable pressure, the normal relation between the rings is altered, so that they are on the same level. Doubtless such an indirect hernia has often been regarded as direct. The position of the deep epigastric artery below an indirect, and above a direct, variety will clear up all doubt.

The *cremaster muscle,* the fibres of which are offshoots of the internal oblique muscle, arises from the middle of Poupart's ligament, descends forming a loop over the infundibuliform fascia covering the testicle and cord, and is attached to the spine at the crest of the pubes.

Bronchial irritation by inducing frequent or violent cough can complicate an operation of this kind very unfavorably. Likewise, any tendency of the patient to vomit during the operation should be met by the administration of more ether. Normal breathing is thus secured and a dangerous interruption of the operation is averted.

The patient should be well clad with heavy flannel undergarments, to avoid any possibility of etherization pneumonia. In all perineal operations, also, heavy flannel drawers are worn by all our patients. Particular care should be taken, since a post-operative pneumonia is a very unfavorable sequel under any circumstances.

Swelling of the testicle subsequent to this operation is not common. It is more likely to occur in the congenital cases, in which a new tunica vaginalis must be stitched about the testicle. Strong adhesions requiring rough manipulation for their separation favor

reactionary inflammation, which may set up an orchitis or an epididymitis. Hence the scrotum is suspended in a bandage, to allow the least chance of inflammatory disturbance.

Operation.—Ether anæsthesia, followed by oxygen. The patient was in the horizontal position. Incision was made from the spine of the right pubes to the right anterior superior spine. The vessels of the superficial fascia were caught with forceps. The deep fascia was divided and the vessels were caught by forceps. The aponeurosis was exposed and cleaned, and the external abdominal ring was demonstrated. The aponeurosis was divided above the canal; it was grasped with tissue-forceps and reflected from the structures of the canal with the handle of the scalpel. The cremaster muscle was demonstrated; the vas deferens was sought and guarded; the sac was separated from the cord by the thumb and index finger of each hand, the fingers being covered with gauze. The sac was freed below, and was dissected upward with scissors; the finger was passed through the internal abdominal ring and the sac was separated above. The sac was lifted and grasped with forceps; it was opened and the finger was passed well within. Its contents were reduced. The sac was pierced with a needle through its neck and was tied by catgut; the suture was passed through the sac until it was completely folded; the needle was grasped with a hæmostat, and was carried within to transfix the external oblique aponeurosis above the ring. The folded sac was carried through the ring by traction on the suture, and was anchored in this position. Sutures of kangaroo tendon were passed from below upward with a straight spear-point needle as follows: through the extreme lower end of Poupart's ligament, beneath the transversalis fascia, through the conjoined tendon and the rectus muscle; through the shelving margin of Poupart's ligament, beneath the transversalis fascia and through the conjoined tendon; through the shelving margin of Poupart's ligament, beneath the transversalis fascia and through the arching fibres of the transversalis and the internal oblique muscles. The last of these sutures was passed carefully to avoid the deep epigastric artery. The cord was drawn outward by a loop of gauze, and the sutures were tied from without inward. The cord was reposited upon its new floor, consisting of the conjoined tendon, the fascia transversalis, the arching fibres of the internal oblique and the transversalis muscles, and the shelving

margin of Poupart's ligament. The aponeurosis of the external oblique muscle was sutured over the cord with a continuous stitch of kangaroo tendon. The vessels included in the forceps were tied. The skin and fascia were closed with interrupted sutures of silkworm gut. Dressings of gauze moistened with a solution of mercuric chloride, dry gauze, and gauze-cotton pads were applied, fixed with adhesive strips and covered by a snugly applied roller bandage, which was bound by adhesive strips. The patient was raised by means of a block placed beneath the sacrum while the bandage was applied.

There was a rise of temperature after the operation, which increased until the fourth day, when it reached 104° F. It gradually subsided, becoming normal on the tenth day. This was caused by a bronchitis. The stitches were removed on the tenth day, and the patient was discharged on the thirty-third day, with a perfect result.

EXCISION OF THE RIGHT UPPER MAXILLA FOR SARCOMA.

A. S., male, white, aged seventy years.—This is one of a class of cases upon which we dislike to operate. The removal of a malignant growth from the region of the face is always followed by deformity, and despite the most radical measures in its removal the condition is likely, sooner or later, to return.

The growth involves the antrum and the hard palate. The patient has gone the rounds among the cancer cures. Among other things electricity has been applied. The patient is old; the mass has ulcerated, and has involved the opposite side of the hard palate. The patient was acquainted with the unfavorable nature of his case, and was aware of the disfigurement and the defects of speech which would follow operation. Nevertheless he accepts operation.

Operation.—Ether anæsthesia, followed by oxygen. During the operation chloroform anæsthesia. The patient was upon a Trendelenburg table, with the head raised and supported by a hard pillow; the thighs and legs were bound to the table with a bandage. The head and ears were covered with a sterile towel, and the chloroform was administered upon a small piece of sterile gauze. A mouth-gag was introduced upon the left side. The upper lip was split in the median line, and the incision was carried around the right ala, up the side of the nose, beneath the lower eyelid, and

out beyond the malar bone. The vessels were quickly caught, and a flap consisting of all the tissues down to the bone was reflected from the maxilla and the malar bone. The mouth had been lightly packed with gauze. The eyeball was lifted and the spheno-maxillary fissure was located. A tongue-depressor was placed in the hard palate was cut fore and aft with a metacarpal saw. A central incisor was extracted, and the cartilages of the septum and the alæ nasi were cut free from the maxilla by scissors. With large bone-forceps the nasal process was cut through; the forceps were placed upon the malar process, the points of the cutting edge being carried to the margin of the spheno-maxillary fissure. The process was cut through, the bone was removed, and the internal maxillary artery at its terminal part was caught with forceps and tied. The fragments of bone were trimmed away with bone-forceps. The involved soft structures were cut away; the inferior dental nerve was removed. The tissues of the left side of the hard palate were cut and seared with the Paquelin cautery. The wound was well sponged and inspected for bleeding points. The wound was then closed; the lip, by two sutures of silkworm gut, which reached down to the mucosa, and which were secured by split shot; the remaining part, by interrupted sutures of silkworm gut. Dressings of moist gauze, dry gauze, and absorbent cotton were applied over the wound and fixed by a roller bandage, which was bound by adhesive strips.

The *deformity* due to the great loss of tissue can be largely overcome by the use of a dental plate. This will not be applied until the tissues have well cicatrized. The deformity is not only improved thereby, but articulation also becomes good.

Hemorrhage from the internal maxillary artery has long been dreaded in this operation. There was a time when a charcoal stone and cautery irons were at hand for the purpose of cauterizing the bleeding tissues. The Paquelin cautery is used for the same purpose to-day. The artery is described in three portions: a maxillary, a pterygoid, and a spheno-maxillary. The first part lies between the ramus of the jaw and the spheno-mandibular ligament; the second is in relation with the pterygoid muscles; the third part, lying in the spheno-maxillary fossa, is readily accessible after cutting through the floor of the orbit, the trunk of the vessel being carefully guarded against injury with bone-forceps.

The *advantage of position* in this instance is that with a pledget of gauze in the pharynx the small amount of blood lost tends to escape by the mouth, and no bronchial irritation or aspiration pneumonia will occur.

Two weeks after the operation, the patient walked into the clinic room. There was perfect healing of the scar and the deformity was slight. Articulation was good.

EXCISION OF THE OVERLAPPING ENDS OF AN UNUNITED FRACTURE OF THE MIDDLE THIRD OF THE FEMUR WITH WIRING OF THE FRAGMENTS.

B. K., male, white, aged twenty years.—This fracture is the result of an accident during a sea-voyage. No physician was at hand, and nothing was done to overcome the deformity. There are about three inches of shortening of the left lower extremity, and the foot is everted. Slight rotation of the foot and thigh is possible, which indicates a fibrous tissue union of the fragments. The skiagraph showed an irregular fracture; the ends of the fragments overlap to the extent of about three inches; the upper fragment is anterior to and to the outer side of the lower fragment. Such a fracture in a muscular individual like this patient would be difficult to treat under any circumstances. Etherization and strong counter-extension would be required to reduce the deformity. An irregular and oblique line of fracture is troublesome, because the ends tend to slide away from one another after reduction. A transverse fracture is easily reduced and maintained in position. A fracture of this kind involving the radius, and not extending into the wrist-joint, is treated by some surgeons with merely a wide strip of adhesive plaster. It is, however, probably safer to treat such lesions as complete fractures of the wrist-joint. The best treatment in this case is to cut down on the fragments through the outer aspect of the thigh, turn these out, and excise the overlapping ends. The fragments being apposed, fixation is obtained by a plaster-of-Paris dressing. Wiring will not be necessary. The plaster dressing will be removed and replaced by another in fourteen days. This is advisable on account of the atrophy of the tissues and the consequent loosening of the plaster encasement.

The causes of ununited fracture are constitutional and local. Among the former alcoholism is included. Failure to reduce

the fragments and to maintain immobilization and the interposition of fragments of bone, muscle, or fibrous tissue are some of the local conditions which retard union. The most common cause is the over-anxiety of the surgeon, which incites him to meddlesome interference. Why is wiring so often required in fracture of the patella? When the result of indirect force, the capsule is torn and the shreds dangling between the bony fragments tend to prevent osseous union. The capsule is often untorn when the fracture occurs as the result of direct force, and in such cases good bony union results from fixation only.

Delayed union is a term which indicates the existence of undue mobility after the normal period of bone repair, six weeks; when this persists after three months the condition is spoken of as an ununited fracture. A fibrous tissue union between the rounded ends of the fragments results in a false joint, a pseudoarthrosis.

Operation.—Ether anæsthesia, followed by oxygen. The patient was in the horizontal position. An incision about six inches in length was made on the outer aspect of the left thigh. The vessels were caught with forceps and the tissues were separated with retractors. The fragments were exposed by dissection. There was some fibrous union between them. The end of the lower fragment was necrotic. The end of the upper fragment was delivered through the wound with some difficulty; some muscular tissue was caught on its jagged surface; there was a mass of soft callus along the linea aspera. The callus was removed; the soft parts were protected by retractors; about one and one-quarter inches of bone were sawed from the end of the fragment. The lower fragment was delivered by carrying the leg strongly inward. Callus was removed by forceps and scissors; about two inches were removed from the end of this fragment, the tissues being guarded from injury by the saw with retractors. The fragments were replaced; as there was a tendency to lateral displacement, wiring was decided upon. The vessels included in the forceps were tied, and the wound was sponged and packed with gauze. The upper fragment was brought out of the wound, and was perforated with a bone drill about three-quarters of an inch from the end; a silver wire was passed through the perforation from below upward and the ends of the wire were grasped with forceps. The lower fragment was drilled in a corresponding position; the wire was passed

from below upward; the bone was held straight by an assistant, and the fragments were apposed and secured by six turns of the wire. The wound was packed and the vessels were tied. Drainage was necessary, a part of the bone having been necrotic. The ends of the wire, therefore, were brought out of the wound. A wet antiseptic bandage was applied and bound with a roller bandage. The leg was shaved on its lateral aspects, and a broad band of adhesive plaster was applied to the sides of the leg from the knee down, the plaster was separated from the malleoli by cotton and formed a loose loop beneath the sole. A roller bandage was applied over this. The anterior portion of the foot, the leg, the thigh, and the lower abdomen were covered with a flannel bandage, over which a plaster-of-Paris fixation dressing was applied. The wire suture was removed on the thirty-eighth day. The bone united firmly. The patient was discharged on the fifty-ninth day.

A *primary dressing of plaster of Paris* is a method of treating fractures in which much confidence may be placed in properly selected cases. It must be used with judgment, and the plaster must be carefully watched and frequently replaced. When used on recent fractures, the plaster should be cut down in the median line before it dries; it can then be quickly removed and with the least disturbance to the patient.

Ambulatory dressings do not yield such good results for the reason that a greater degree of consecutive shortening follows their employment. This is in consequence of bone resorption, and is well illustrated in cases of fracture of the neck of the femur in which slight primary shortening may be followed later by three inches of shortening. The friction of the ends of the bones in attempts to walk in the ambulatory plaster apparatus is sufficient to induce a similar active process of bone resorption at the site of injury. If it is desirable to have the patient walk about, he should use crutches to relieve the injured leg of the body weight. Later, when bone deposition is advanced, one crutch may be discarded and then the other, a cane being substituted. The gradual pressure thus brought upon the leg seems to favor the process of repair.

Conservative treatment will yield good results. In a case of multiple fractures involving both thighs and one arm, the fragments of the right femur were wired. On account of the poor physical

condition of the patient the other thigh was treated in plaster, the patient given crutches, and forced to walk. The results were equally good.

COMPLETE RECTAL FISTULA.

M. E., female, white, aged twenty-six.

Fistula in ano is a local condition, depending frequently on a constitutional disease. It is common in tubercular patients.

The ischiorectal region is of low vitality. The part is dependent, and made up of loose fat to allow distention of the rectum. The blood-supply is poor and the vessels are not well supported. Slight traumatism resulting from suddenly assuming the sitting posture or from exercise on a bicycle or on horseback may be an exciting cause in a patient rendered susceptible by tuberculosis.

The varieties of fistula in ano are the complete and the incomplete; of these the last mentioned is further subdivided into the internal and the external.

The complete fistula is that condition in which there is an abnormal channel between the rectum and the skin by way of the ischiorectal fat. The incomplete fistula has a single opening communicating either with the rectum or the skin. An opening from the bowel into the ischiorectal region which does not communicate with the skin constitutes an incomplete internal fistula; when the sinus leads into this space from an opening on the skin and does not invade the bowel, it is described as an incomplete external fistula.

The treatment of a complete fistula consists in the division of the tissue intervening between the sinus and the rectum, the wound healing by granulation. The incomplete internal fistula should be converted into a complete one and treated in the same manner. The incomplete external should be incised and curetted. Division of the external sphincter may, however, be necessary, as the dragging of the muscle on the granulations tends to maintain the fistula.

The internal sphincter should be avoided, as it would suffice to prevent incontinence of fæces if repair of the external sphincter prove not to be complete.

In a horseshoe fistula the sinus should be opened up all around, the external sphincter being divided in one place only. All communicating tracts must be freely opened, but the bowel should

be opened by a single incision only. The dense cicatricial tissue may be excised.

If the sinus extend high along the rectum, free incision would lead to very copious hemorrhage. The elastic ligature may be used. The margin of the anus should be divided, and the ligature introduced and tied at the base. It will gradually cut its way through.

Attempts have been made to dissect out the fistulous tract and cicatricial tissue and in this way to obtain primary healing by suture. Healing by granulation is the best method.

A theory has long prevailed that healing of the fistula is followed by the symptoms of incipient phthisis and that these symptoms disappear when the fistula redevelops. There is undoubtedly some reason for this view. Therefore be guarded in your promise of a cure and invariably make an examination of the lungs. Operation for fistula should not be undertaken in advanced cases of phthisis.

Operation.—Ether anæsthesia, followed by oxygen. The patient lay upon his right side with the thighs flexed. Drops of pus were seen exuding from two openings on the right side. The right ischiorectal region was dense and firm from the presence of cicatricial tissue. A grooved director was passed along the sinus from without inward. The instrument was flexible and followed down the tract, emerging through the internal opening against a finger introduced into the rectum. The inner end of the director was brought down through the anus and the sinus tract was laid open by a curved bistoury. The second sinus was opened into the first incision. The margins of the sinus were freshened by scissors and the wound was packed with iodoform gauze. Dry dressings and a perineal bandage were applied.

Patient was discharged on the eighth day, with a small granulating wound.

EXTIRPATION OF A RECURRENT EPULIS OF THE RIGHT MAXILLA.

B. A., male, white.—The growth is polypoid, about the size of a hazel-nut, and occupies the alveolar border of the right maxilla, apparently anterior to the last molar tooth. It is adherent to the periosteum. The growth recurred after operation one year ago. This is regarded as an osteosarcoma. The subjacent periosteum

should always be removed, and if the mass is strongly adherent the underlying bone also. In growths on the face or cheek of possible malignancy radical operation is the only procedure that yields satisfactory results.

Operation.—Ether anæsthesia, followed by oxygen. The patient was in the recumbent position with the head well raised. A mouth-gag was introduced on the left side. The cheek was split in a direction downward and outward from the angle of the mouth on the right side. The facial and coronary arteries were secured and tied before cutting through the buccal mucous membrane. The growth was cut away with scissors. The teeth anterior and posterior to the mass were removed by dental forceps. The alveolar border was cut through by lion-jaw forceps and removed. The buccal mucosa was sutured by a continuous catgut stitch, the ends of the suture being buried beneath the mucosa. Interrupted sutures of silkworm gut were introduced from without, extending down to the mucosa. Dry gauze dressings were applied and fixed by a gauze bandage.

HIP-JOINT AMPUTATION BY WYETH'S METHOD FOR RECURRENT SARCOMA.

The patient, a young girl, was operated upon before the clinic during November. She had recurrent sarcoma after an amputation in the middle third of the thigh. Wyeth's pins were used. The stump was packed through the lateral incision with iodoform gauze. In the reaction from the vasomotor paresis induced by the rubber compression, there was bleeding into the stump, and a blood-clot formed in its centre and directly over the femoral vessels. The clot was not disturbed, but all sutures were removed and complete drainage was established. This was also of advantage in view of the possible infiltration of the stump with sarcoma cells. The lateral flaps are now healed, the inferior flaps are covered with painful granulations, and the anterior flap is slightly adherent. The cavity was packed with iodoform gauze. The stump was redressed with gauze and cotton and by a roller bandage, which was bound by adhesive strips.

FOREIGN BODY IN THE NECK.

W. L., male, white, aged twenty-three years.—A piece of steel entered the left side of the neck just below the middle, at the anterior border of the sternocleidomastoid muscle. There is extensive

ecchymosis, extending above the wound of entrance to the angle of the jaw and anteriorly to the median line. The x-ray plate locates the mass behind the posterior border of the left sternocleido-mastoid muscle in its lower third. Incision may change the aspect of this, however. The skiagraph is not absolute as regards distance. There is no indication of the depth of the foreign body beneath the surface. Only one skilled in the study of the skiagraph can intelligently interpret the plates. In the children's ward we made an extensive dissection of the foot to remove a needle which was clearly outlined in a skiagraph. We could not find it; and the dissection was probably more destructive than will be the presence of the needle.

Operation.—Ether anæsthesia, followed by oxygen inhalations. The patient was in the horizontal position. The wound was laid open over a probe. The body was sought for in the position located by the skiagraph, but was not found. It had apparently gravitated away from the position indicated in the skiagraph. The wound was closed by interrupted sutures. Dry dressings and gauze bandage were applied. With the exception of a slight bronchitis, the patient made an uneventful recovery. The stitches were removed on the ninth, and the patient was discharged on the tenth day.

SPLENECTOMY.

BY JOHN R. WATHEN, A.B., M.D.,

Professor of Pathology and Clinical Professor of Gynæcology in the Kentucky School of Medicine; Visiting Surgeon to the Louisville City Hospital and Kentucky School of Medicine Hospital; Member of the Kentucky State Medical Society, Louisville Society of Medicine, and Louisville Clinical Society, etc., Louisville, Kentucky.

OUR knowledge of the removal of the spleen dates from the year 1867, when Péan, of Paris, successfully removed an enlarged cystic organ. Since then many cases have been recorded, with but a small mortality. The chief indication for the operation is enlargement and its attending pain, although splenectomy has been performed for leukæmia, hypertrophy, cysts, malignant disease, abscess, degenerations, tumors, traumatism, parasitic diseases, and wandering or dislocation of the organ. The spleen has been but little studied or understood, and I will briefly allude to its surgical anatomy in order better to consider its pathologic conditions.

It is a ductless organ, classified as a compound lymphatic gland. It is situated in the left hypochondriac region, weighs about seven ounces, and is five inches long, three or four inches wide, and one and one-half inches thick. In shape it is oblong and flattened; it is soft, very vascular, and of a dark-blue color. The spleen is held in position by the gastrosplenic ligament, which connects it with the stomach, and by a fold of peritoneum that reaches to the under surface of the diaphragm and is called the suspensory ligament. It is also supported by the gastrocostic and phrenicocolic ligaments, upon which the lower end rests.

The under surface has a ridge which extends from the upper to the lower end of the spleen and separates two well-marked concave areas. The anterior area is in contact with the posterior aspect of the cardiac end of the stomach, while the posterior is in relation with the left kidney. The tail of the pancreas and the splenic flexure of the colon cause impressions upon its surface. The anterior

border of the spleen has several notches which aid in diagnosis, while the posterior border is rounded and smooth.

The blood-supply is from the splenic artery, a branch of the cœliac axis, and is very large in proportion to the size of the organ. The artery, veins, and nerves enter the hilum of the spleen through the gastrosplenic omentum, which can surgically be called the pedicle of the spleen.

The spleen has long been considered to be a blood-forming organ, especially the white cells, or leucocytes, and by some considered the graveyard for the red blood-corpuscles.

The capsule is composed of an outer serous or peritoneal and an inner fibro-elastic coat, from which fibrous bands, or trabeculæ, are given off, which penetrate the splenic pulp and constitute the framework of the organ. This capsule also contains a few non-striated muscle-fibres, which contract when injured and assist in checking hemorrhage and vascular structure.

Spherical masses of dense adenoid tissue, called the Malpighian corpuscles, appear throughout the spleen and ensheath the arteries. The arteries and nerves lack the characteristic arrangements seen in other organs, and the blood appears to be emptied into the pulpy structure to be changed or regenerated and then filtered into the veins of the spleen.

Variations in the size of the spleen have often been noticed in healthy subjects and at post-mortems. Albrecht, of Vienna, reports at least five hundred spleens which varied in size from a pin-head to a walnut. Martin, of Berlin, reports absence of the spleen without even the splenic artery being given off from the cœliac axis.

After removal of the spleen in adult man, a rapid diminution in the number of red cells and percentage of hæmoglobin takes place, with a corresponding increase in the number of leucocytes; but after a few weeks the blood again becomes normal, the work of the extirpated organ evidently being performed by the lymphatic glands and bone-marrow.

Careful examinations of the blood should be made in every case of splenic enlargement, both before and after operation, as these will often throw much light upon the diagnosis and treatment.

Cabot says, "The destruction lies not in the number of leucocytes nor in the duration of the increase (since leucocytosis not infrequently shows a higher count than leukæmia and may last

longer), but in the kind of leucocyte increased. In leucocytosis only the polynuclear forms are increased; in leukæmia the lymphocytes or myelocytes make up the bulk of the increase. In the fresh specimen, examined between slide and cover-glass or in the Thoma-Zeiss counting chamber, the distinction of the different kinds of leucocytes is not practicable. Only in the stained cover-slip preparations can the differences be properly seen."

Concerning the many pathologic conditions of the spleen which call for operation, there has been much discussion, and opinions and statistics have varied widely.

In leukæmia, a frequent cause of splenic enlargement, most surgeons have agreed not to operate, as those cases in which the organ was removed have been attended by a high mortality. In cases of simple hypertrophy, abscess, cysts, or injuries to the spleen, most surgeons favor its removal.

Special attention has recently been called to the association with cirrhosis of the liver, not due to alcohol, but to an unknown infective process. Probably in these cases the spleen was first attacked and it acted injuriously on the liver; if this hypothesis is correct, splenectomy would then be prophylactic of later developing disease of the liver.

The symptoms of the various pathologic conditions which demand removal of the organ are necessarily varied, but a tumor or enlargement in the location of the spleen and often associated with pain should be our guide. Extensive adhesions, large size of the spleen, its degenerated or softened condition, and a broad vascular pedicle would furnish complications or contraindications in its removal.

In the operation of splenectomy the incision should be made over the most prominent part of the tumor, if large, but, if small, in the left linea semilunaris. We should begin to separate adhesions, which are usually present and quite extensive, from the lower part and gradually work up towards the pedicle. The incision should be large, in order to watch and control hemorrhage, which is the thing most feared in this operation, and comes from adhesions, the large vessels in the gastrosplenic omentum, or surgical pedicle, and is aggravated by the general softened condition of the organ.

Never attempt to lift out or make traction upon the organ with volsella, as the tissue is soft and friable and traction causes a tear

with much hemorrhage, but let an assistant support the spleen and gradually elevate it without tension upon the ligaments and vessels.

The gastrosplenic ligament should first be clamped and divided between the two forceps. This will allow us better to elevate the organ and reach the large vessels. Next we clamp the vessels as we did the gastrosplenic ligament, and then in like manner sever the suspensory ligament. The spleen being removed, the vessels should be tied separately with catgut or silk and the pedicle also ligated *en masse.*

Those operators who have done the most surgery upon the spleen prefer silk to catgut, because it is not so quickly absorbed in such a vascular area, upon large vessels is more reliable and easier knotted without loosening, and for various other reasons.

The fatal results have nearly all followed hemorrhage due to the great difficulty of ligating the vessels, on account of their location and size.

By the statistics alone are we able to judge the value of the operation of splenectomy.

Hartley and Bovee, who have collected the percentages of mortality for splenectomy, excluding those of leukæmia and amyloid and malignant diseases, give the following: for simple hypertrophy 9 per cent. mortality, malarial enlargement 42.2 per cent., wounds 16 per cent., axial rotation 20 per cent.; echinococcus and other cysts 16.6 per cent., and rupture 6 per cent.

I will conclude with a report of the following case. Mrs. P., aged forty years, was referred to me by Dr. Nickel, of Caney, Kentucky. She had a large tumor of the abdomen, resembling an ovarian cyst. I opened the abdomen at the Kentucky School of Medicine Hospital, and found the tumor to be a much enlarged spleen, weighing between six and ten pounds, the tissue of which was quite rotten; much hemorrhage occurred after separating the adhesions. The pedicle was very large, being about six by two inches in cross section, and the spleen seemed to be a malignant rather than a simple hypertrophied organ. I thought best not to remove the tumor, and so closed the abdomen, packing gauze against the tumor to check some hemorrhage from the surface due to the torn adhesions, and bringing it out at the lower end of the incision. This was removed about a week later and the patient returned home in four weeks. Blood examinations after the operation showed no leukæmia, although examined often for this condition.

Obstetrics and Gynæcology

RESOURCES IN NARROW PELVIS.

CLINICAL LECTURE.

BY R. C. BUIST, M.A., M.D.,
Gynæcologist to the Dundee Royal Infirmary.

GENTLEMEN,—Cases of narrow pelvis are occasionally seen in private practice as well as in hospital, and as you have no guarantee that your first case will not be one of this kind or that you will be called before interference is urgently needed, it is important to have both the needful knowledge and your wits about you, so that you may act at once in the best interests of your patient, or rather patients, for there are two of them,—mother and child,—whose lives may depend on your skill and promptitude.

In hospital practice, where a systematic examination of every patient is made, one has a fair chance of discovering the condition beforehand, and consequently of being able to guard against any complication due to narrowness of the pelvis by applying measures calculated to reduce the difficulty, and it is advisable to endeavor to secure the same advantages in your own practice. It is your duty to know the condition of the urine of a pregnant patient, and equally to consider whether or not the pelvis is contracted. The latter can be definitely ascertained only by measurement, which, unfortunately, is not always permitted; but if a patient is undersized or has an abnormal gait or carriage, it is imperative that measurement be advised and judiciously pressed.

In measuring the pelvis it is important to know the size of the conjugate diameter at the brim. This is not always feasible owing to the protrusion of the uterine swelling into the vagina, and one is then reduced to circumstantial evidence as to its amplitude. The interspinous, intercristal, and intertrochanteric distances can

always be measured, and if, on passing from one to another, an increase of an inch is found, it is probable that the pelvis is nearly normal. Regularity in the increase is more important than absolutely larger measurements. Michaelis drew attention to the form of the diamond-shaped area over the sacrum, bounded by the borders of the glutei and two lines from the posterior superior iliac spines to the groove at the upper border of the sacrum, as an indication of pelvic deformity, and bilateral inequality or great flatness of the upper half indicates a pelvic contraction which measurement may or may not confirm.

When slight pelvic contraction has been discovered some time before the end of pregnancy, Prochownik, of Hamburg, advises that the patient be put on a special diet restricted both in quantity and quality, as follows: morning, coffee with three-quarters of an ounce of biscuit; noon, meat, eggs, fish with very little sauce, green vegetables without fat, salad, and cheese; evening, the same with one and a half ounces of bread. Drink, half a pint of red wine daily. Avoid water, soup, potatoes, pastry, sugar, and beer. It is difficult to apply scientific tests to such a method, but a number of cases have been recorded in which it seemed to do good. In the case of a patient with a nine-centimetre conjugate whose first two children were born dead after very hard labors, in the second of which I had been called in to complete turning and was obliged to apply forceps to the after-coming head, I advised her doctor to put her on this restricted diet. Whatever the cause, her third child was much smaller and was born spontaneously. It is doubtful whether the size of the child can always be lessened by starving the mother, but the soft tissues in the pelvis are frequently so much reduced by this means as to add slightly to its roominess. This is to be considered only when the contraction is slight.

When in the course of pregnancy the pelvis is found to be much narrowed several questions relating to practice must be decided, but especially whether premature labor shall be induced, and, if so, when. The main objection to this procedure is that premature children are so difficult to rear that often the infant, though born alive, lives only long enough to make the mother feel its loss the more. In many cases the question is simply as to the amount of care and knowledge which can be applied to the guidance of the child, and therefore the objection to inducing premature labor is

less in wealthy patients than among the poor, where even full-time children die in such large numbers. Even among the latter class one cannot forget the wonderful results attained by Dr. John Moir, of Edinburgh, who, practising before either antiseptic or aseptic midwifery was known, had, of seventy-two children delivered by induced premature labor, fifty-nine not only living but likely to live. The narrower the pelvis the earlier must be the labor to allow the child to be born alive, and as the earlier the period at which pregnancy is interrupted the less likely is the child to survive, the adjustment of these two elements sets a limit below which the induction of premature labor need not be considered. For the pelvis this is a three-inch conjugate, through which an average child beyond the thirtieth week can hardly be delivered. Where the pelvis is not so narrow as this, the operation may be delayed with safety to the mother, and if two weeks extra be allowed for every quarter-inch by which the conjugate exceeds three inches, a fair working rule will be obtained. So far I have been dealing with average children; if the child is unusually large or small the practice must be modified by hastening or postponing the operation.

The question of the period which pregnancy has reached may often be determined from data furnished by the mother, though these are frequently so untrustworthy that it is well to resort to another means of settling the point. This consists in the measurement of the child, and is of importance as showing the period of an average pregnancy corresponding to the size of the child in question rather than the stage which the particular pregnancy has reached, and by subtraction the number of weeks during which the pregnancy may be allowed to continue. In a multipara the child is measured by taking with calipers the distance from the upper edge of the pubic symphysis to the upper pole of the fetal body and doubling the measurement. From this, taking the measurements in centimetres, Ahlfeld gives a simple way of reckoning the period of the pregnancy. From this double measure subtract 2, and divide the remainder by 5. The quotient will give the number of months completed and the numerator of the remaining fraction the extra weeks. Thus, if the distance from the pubis to the fetal pole is 24 centimetres, 48 – 2 (or 46) must be divided by 5, giving $9^1/_5$, corresponding to nine lunar months and one week. The result of this method agrees with the averages of fetal weight given

in different tables, and, as it depends on the actual size of the infant, there is no need to consider whether the child is unusually large or small. In a primipara the measurement is made by placing the lower end of the calipers against the lower fetal pole in the vagina. This, however, is of no importance here, as the induction of premature labor is very rarely justifiable in a primipara.

When premature labor has been decided on, it should be attempted about a week before the period at which it is imperative to secure it, at least if any one of the older methods is to be employed, and usually several repetitions are necessary before labor actually sets in. Of the older methods, Krause's, of inserting bougies into the uterus, is as good as any, and the only newer method that is any better is that of dilating the cervix sufficiently to allow of the insertion of a Champetier's conical bag. The bag, with, if need be, traction on the tube, is a sure and at the same time gentle method. The injection of glycerin into the uterus seemed full of promise, but has proved as uncertain as the others, while grave cases of urinary hemorrhage have followed its use.

Generally, by reason of the inadvertence of patients, or from the set purpose of the physician, the latter has to deal with the problem of narrow pelvis at term. At this period his attention is drawn to the narrowness of the pelvis sometimes, unfortunately, only by the delay in the labor. When called in early there are, however, several indications which may put him on his guard. If the patient be a primipara, and he finds the head still above the brim of the pelvis, the cause is frequently a serious disproportion between the size of the head and the diameter of the pelvis. If the patient is not a primipara, the history of any former labors may tell the practitioner what to expect. In this respect, unfortunately, the positive evidence of a previous difficult labor is frequently verified by another of the same, while a series of easy labors may be succeeded by an equal or longer series of labors of increasing difficulty. The reason of this is that first children are usually the smallest: there may be a successive increase of nearly half a pound in children of the same mother. This emphasizes the fact that pelvic narrowness is a matter relative to the size of the head, and thus a slight degree of contraction that has not greatly hindered the delivery of a small first child may be a source of increasing difficulty as each child is heavier than its predecessor.

A pendulous abdomen in a woman who has had only one or two children should always arouse suspicion.

Another sign which may point to narrowness of the pelvis is early escape of the waters. The patient's statement that the waters have escaped is not always correct and the physician must verify it by examination. When the membranes have really ruptured prematurely it adds seriously to the risks of labor to the mother and still more to the child. It increases the duration of the first stage, as the head is both less fitted and less gentle as a dilator than the elastic bag of waters, and it exposes the child to compression at a much earlier period; also, when any operation or manipulation is necessary the uterus is more liable to rupture. Formerly the only way to obviate these dangers was to shorten the first stage by dilating the os by hand, but the practitioner now has a fairly good substitute in semi-elastic conical bags of the form used by Champetier de Ribes. It has been said that these are apt to alter for the worse the position of the head, but this has not taken place in the cases where I have used the method. On the contrary, the bag has acted as a gentle dilator, and by pulling on the tube either by hand or by weights hung over an extension apparatus it has also, without injury, shortened the time very considerably. Consequently, I am wholly in favor of the method at term as well as in premature labor. At times before rupture of the bag of waters it may be seen projecting from a narrow os like the finger of a glove. This is a classical sign of pelvic contraction and is usually followed by early rupture.

When narrowness of the pelvis has been discovered only at term, the first recourse of the physician is to Walcher's discovery or rediscovery of the fact that the distance of the pubic bone from the sacrum can be modified by posture. To secure the advantages of this method the patient is brought to the edge of the bed or table with the buttocks just over the edge and the thighs and legs hanging down without the feet touching the floor, while some one holds her shoulders to prevent her falling out. The trunk is thus resting on the back of the sacrum and the leverage of the limbs tilts the pelvis down so that the pubis lies more opposite the hollow of the sacrum. The distance from the promontory to the pubis is thus greater, the increase being sometimes a centimetre or more. This, of course, is at the brim of the pelvis; at the outlet the effect is

just the reverse. There the diameter is increased by putting the patient in the lithotomy position, which contracts the brim by bringing the pubis nearer the promontory. Thus, to get the best result from this change of posture, the hanging-leg position must be used till the head is past the brim, and the lithotomy position to meet any trouble at the outlet. Difficulty with the shoulders may be disposed of in the same manner. One corollary which may be drawn is that it is easier for the head to enter the pelvis when the patient is in the extended position than when her legs are drawn up. There has been considerable discussion of the scientific evidence of this change in the pelvic diameters on change of position. When the practitioner meets with a case in which the head is stuck at the brim, and has applied forceps in the ordinary position without success, he will, on trying again with the patient in the hanging-leg position, be fully convinced of the value of the method. I do not mean that he will be able to deliver all women by this device, but where a gain of half an inch will serve his purpose, it may be got in this way. Jardine had such an experience, and delivered an eight-and-a-half-pound child through a two-and-three-quarters-inch conjugate.

The gain at the brim by change of posture may be very useful in cases which can be delivered without operative interference, and where recourse to forceps is necessary it may render a difficult case easy or an impossible one possible. I therefore advise its employment whenever forceps are to be applied at the brim.

Forceps are the traditional stand-by of the obstetrician when spontaneous labor is despaired of, but as yet there is little general agreement on the many questions of detail involved in their use. An ordinary instrument catalogue lists thirty forms: long and short, axis-traction with or without special handles or rods,—all are there in bewildering profusion, and the choice of an instrument seems an even more puzzling problem than when to use it. There is no doubt that a skilful accoucheur can deliver most of his cases with any forceps, yet even the strongest opponents of the axis-traction forceps will admit that in specially difficult cases these give a slight advantage, and in this admission give away their whole case. One not accustomed to axis-traction forceps by his mere unfamiliarity with them sacrifices this advantage, which be it ever so slight may prove the turning-point of the next case he has to deliver. As an

offset to this advantage the opponents of the instrument urge the complexity of its mechanism and a consequent awkwardness in handling, but the awkwardness disappears with increasing familiarity with the instrument and the complexity will be found of little importance in practice. My advice is to use axis-traction forceps whenever forceps are needed at all, and in extreme cases the instrument will not fail to supply the little extra purchase required. Do not fear that midwifery work will become more mechanical or less intelligent. It will be very limited indeed if it do not call for constant mental alertness and, on occasions, for all the skill the hand possesses and all the knowledge the mind can bring to its aid.

I have noticed that many practitioners have difficulty with the forceps from apparently not realizing how far forward the upper part of the axis of the pelvis passes and from consequently not carrying the handles of the forceps far enough back against the perineum. The result is that the point of the blade meets the upper part of the sacrum and does not take hold of that diameter of the head which is in the pelvic axis. It is much safer to carry the handles as far back as possible, for it is not at this stage of the operation that the perineum is endangered.

In the minor degrees of flat pelvis it was formerly the almost universal practice to turn, on the ground that this let a smaller diameter of the head, and one which was not so much affected by compression from back to front, to come into the conjugate at the brim. This method, however, is not now so generally in vogue, and many think traction-rod forceps a safer mode of delivery in such cases. On theoretical grounds, reinforced by practical experience, this is my own opinion also, but one should be guided by the circumstances of the individual case and avoid any rigid rule. The history of a patient at whose last three labors I have been present illustrates this and several other points. She is now forty-seven, and has a three-and-a-half inch conjugate. Her first two labors were easy, the next three were instrumental, and she had then a series in which the presentation was always occipito-posterior and the children were delivered by turning, several being stillborn. At the tenth labor the presentation was again occipito-posterior, and, the membranes being whole, I used external version and delivered a living child, but fractured the right humerus. The eleventh labor

was also with occipito-posterior presentation, and I delivered the child by internal version, dead. At the twelfth labor I delivered a living child by forceps, and should she again need my help, I expect to give it best in this way.

In the question of turning there are one or two points of practical importance. Turning is sometimes resorted to when delivery by forceps has failed. This is not good practice. The waters have usually completely drained away, and there is danger of rupturing the uterus. If forceps fail and the child be dead, perforate the head and divide one or both clavicles, but never turn. The failure to turn does not, however, forbid the trial of forceps. The question of the proper knee to seize in turning has recently been systematized by Berry Hart, who points out that in dorso-posterior cases the farther knee pulls them round into dorso-anterior, and in cases already anterior pulling the near knee leaves them still anterior and so in the most favorable position for delivery. If the membranes are still intact and the liquor amnii abundant, turning may be accomplished by external pressure alone, and as this shortens the time during which the child is in danger and greatly reduces the intra-uterine manipulation, it is very desirable to do so. To succeed, the muscles of the abdomen must be thoroughly relaxed, a hand placed on each pole of the fœtus, pressed round in the same direction, shifting both gradually so as to keep up a continuous movement. When it is complete, rupture the membranes.

It was formerly considered necessary to break up the child when delivery by forceps or turning had not succeeded, even when the latter was still alive. This can now be justified only by urgent danger to the mother. Neither waiting till the child dies nor embryotomy of the living child can ever be considered other than a parody on obstetrics.

The recent revival of symphyseotomy and the gradually increasing simplification of the method have considerably increased the possibilities of safe delivery, and although the opinion seems to be generally entertained that this operation cannot safely be done outside of a hospital, I myself believe that by Ayer's plan of subcutaneous operation symphyseotomy may be performed in private practice without additional risk. The mode of operation is as follows. Pull up the clitoris and make a small incision under it;

pass a director through the opening and along the front of the symphysis; put a sound in the urethra and have an assistant hold it to one side; pass a probe-pointed bistoury along the track of the director to the top of the symphysis in front; with the left forefinger in the vagina feel the point of the knife above the pubis and, keeping the two constantly in contact, cut down through the cartilage. The incision may bleed freely and need to be plugged. An assistant should keep the legs from springing too widely apart. The cut ends may separate three inches, and, in addition to the increase which the rotation about the sacro-iliac joints gives, there is a further practical increase due to the elasticity of the soft tissues that fill the gap. Afterwards the patient must be kept in bed for four weeks with the legs tied as for a torn perineum and with a bandage round the pelvis. If the symphysis does not solidify, no harm seems to result. Delivery should be completed by forceps. The gain in symphyseotomy is fully half an inch.

In cases in which it seems unlikely that this gain of half an inch will be sufficient, the ultimate resource lies in Cæsarean section. The performance of this operation outside a hospital can be justified only by extreme urgency; but as in most cases where it is likely to be needed the patient comes under observation beforehand and transmission to a hospital can be arranged, I do not discuss it in detail or debate the questions of conservatism or of sterilization.

The provinces of the different methods cannot absolutely be defined, as the size of the child's head makes that of the pelvis a relative one. In a general way it may be said that, with a conjugate diameter above three inches, forceps or turning with the hanging-leg position will suffice for most cases, while induction of premature labor may be found necessary by reason of a bad previous history. A pelvis with a conjugate below two inches calls for Cæsarean section, while symphyseotomy is the operation of choice in suitable cases between two and a half and three and a half inches. In the case of a dead child, embryotomy may facilitate delivery in any stage of contraction.

ABORTIONS.

A LECTURE DELIVERED IN THE ROYAL MATERNITY AND SIMPSON MEMORIAL HOSPITAL, EDINBURGH.

BY J. W. BALLANTYNE, M.D., F.R.C.P.E., F.R.S. (Edin.),

Lecturer on Midwifery and Gynæcology, Medical College for Women, Edinburgh; Lecturer on Antenatal Pathology and Teratology in the University of Edinburgh (1900).

Gentlemen,—An abortion is the termination of a pregnancy before the proper time; it is, more exactly, its termination before the fœtus is viable or capable of existence apart from the mother. The term "premature labor" is reserved for the termination of pregnancy after the date when the fœtus is viable but before that when it is mature, for viability does not include maturity any more than puberty includes nubility. It is to be remembered, however, that we cannot frame any very strict definition either of abortion or of premature labor, for the date of viability cannot be fixed; it is indeed being moved gradually backward by the invention of more effective means of keeping alive the fœtus expelled before its time. With the help of the couveuse and the specialized wet-nurse, the six months' fœtus has now a better chance of surviving birth than it would have had some ten or fifteen years ago; and so the date of viability must now anticipate the seventh month of antenatal life. Nevertheless, it is convenient, even if it be not strictly accurate, to call confinements occurring in the last three months of pregnancy "premature labors," while the names "abortion" and "miscarriage" are given to interruptions of gestation in the first six months. It has further been suggested to give the name "abortion" to interruption in the first trimester and "miscarriage" to interruption in the second trimester of pregnancy; but this is an even more artificial distinction than the last. In this lecture I understand by "abortion" the termination of gestation before or about the third month of utero-gestation.

This is not the only sense in which "abortion" is used in medicine and science. By a slight extension of meaning we say that

structures or parts which undergo arrested development and remain in a rudimentary condition are "aborted;" thus, in botany, spines are aborted branches. Further, an "abortion" may mean either an infant prematurely born, or one who is imperfectly developed,—a monstrosity. The word is also employed outside of medicine and science in a figurative sense; and in the newspapers and ordinary literature we commonly read of "abortive enactments," "abortive measures," and the like. Finally, there is a somewhat curious use of the word "abortive" of which we may in passing take note; it means a kind of fine parchment or vellum made from the skin of a stillborn animal,—an aborted calf. Here and now, however, we are concerned solely with "abortions" in the ordinary and obstetrical sense of the word.

An abortion, then, is *a disappointment*. It is, or ought to be, to the mother; but it has to be sadly admitted that she is not always disappointed when the fruit of her womb is untimely shed. There are "criminal abortions" which do not come under the legal definition of the word; and many a woman has lived to repent the feeling of elation with which she welcomed the premature emptying of the womb and the consequent release from the irksome restraints of pregnancy. With the menopause near at hand, with nothing to show of the nature of reproductive activity save the acquired habit of aborting, a woman may well repent the means she took to rid herself of her gestational burden and the joy which she felt when these were successful. There is a Nemesis in such matters. An abortion is also a disappointment to the relatives, save to those whose financial hopes a full-term pregnancy may blight; it is a disappointment to the doctor and nurse engaged to attend the mother in her confinement, for neither a doctor's nor a nurse's practice can grow upon abortions. Possibly it may be less of a disappointment to some gynæcologists, for if it were not for abortions, and more particularly for incomplete or improperly treated abortions, many cases which seek the gynæcological specialist and help to swell his list of operative triumphs would never need to visit his consulting-room at all. If we regard it, however, from the right stand-point, an abortion is, let it be repeated, a disappointment.

Further, it is a disappointment which having occurred once is apt to recur many times. There is no general characteristic of

abortions which is more certain than their *tendency to recur.* The occurrence of a series of abortions in the reproductive history of a patient makes us think at once of syphilis, and there can be no doubt that in the presence of syphilis such an occurrence is common; but abortions due to causes other than syphilis also show this recurrent tendency. For example, the interruption of pregnancy arising from uterine displacement or from chronic endometritis also is apt to repeat, especially if the cause be left unremoved. It may indeed be said, almost as a general rule, that just as every abortion is first a threatened abortion so every completed abortion tends to become a recurrent abortion. In the case of syphilis the tendency may show signs of gradual disappearance, especially if regular antisyphilitic treatment have been adopted; but in abortion due to alcoholism, for instance, the tendency will persist and increase, unless, indeed, total abstinence be acquired and maintained. If we do but keep in mind this recurrent character of abortions, we may be able in ensuing pregnancies to enjoin such prophylactic measures and give such effective remedies as to prevent the recurrence. Unfortunately, it too often happens that no warning is given to the patient, or if given it is not taken to heart, and when we next are sent for a new abortion is already in progress. To the nature of the prophylactic treatment I shall return in a few minutes.

Another general character of abortions is their *frequency.* It may be possible by means of an improved system of registration to arrive at an estimate of the frequency of premature labors; but the frequency of abortions can hardly be estimated at all, for many of the early interruptions of pregnancy never come under the notice of the medical attendant and some of them are scarcely suspected by the mother herself. The statement that one pregnancy out of every five ends in an abortion is probably an underestimate. There is thus an appalling loss of fœtal and embryonic life. In these days, when the falling birth-rate observable in many large cities, and even in country districts as well, is beginning seriously to engage the attention of political economists anxious for the prevention of national decay and death, it may be reasonably asked whether everything is being done to check this great source of loss of antenatal life. It has been objected that the embryos of abortion cases are not normal, not worth saving; but it would seem rather that the em-

bryo is rarely the cause of the abortion, that, in fact, the decidual membranes and the forming placenta are most commonly the structures which show distinct pathological changes. At any rate, there is no conclusive evidence that the embryos of abortion cases are often so morbid as to be incapable of growing into healthy, normal, and mature fœtuses if their intra-uterine life were continued long enough. Certainly, if even the cases of abortion due to *local* causes could be prevented, there would be a very valuable factor in action to check the falling birth-rate.

As is well known, abortion is most apt to occur at or about the third month of pregnancy: that is its *period of predilection*. There must be some reason for this. In order, now, that the reason may be plain, let us picture to ourselves the state of matters inside the uterus at this date in antenatal life. From the sixth week to the end of the second month is a transition time in intra-uterine existence. At the sixth week the new organism is an embryo; at the eighth week it is a fœtus; in the interval it is the transition organism, or embryo-fœtus. The interval of two weeks may be called the *neofœtal period*. Before the neofœtal epoch the organism was an embryo and had showed its vitality chiefly by the marvellous series of constructive changes through which it passed, and by which it was brought from a morula chaos to a complex embryonic cosmos; after the neofœtal period the organism is a fœtus,—that is to say, it is recognizably human, and henceforth its activities are in the direction of growth rather than of construction: it increases in size and weight; it no longer develops; it grows. Further, its environment has also altered: at the beginning of the period the decidual membranes are at their maximum degree of development and no indication is yet forthcoming of the future placenta, the umbilical vesicle also is still relatively large and the omphalomesenteric circulation of some importance; at the end of the epoch the decidual membranes (vera and reflexa) are beginning to yield in importance to the decidua serotina, and the chorion, instead of being villous all over, now shows a special zone of great villous and vascular development in connection with the serotina,—in other words, the placenta is forming, and in future the allantoic placenta is to take the place of the umbilical vesicle and the more generalized chorionic-decidual connectious. There is thus a sort of birth before birth, a transition not so sharp and abrupt as that

which occurs when the infant is born, but sharp enough to bring some danger with it, for transition-times are always danger-times. While an army is taking up a new position, it is a bad time for it to be attacked. Let me try to illustrate the danger and its cause in another way. Let us suppose that a ship is lying near the land fixed by means of strong ropes to a number of buoys arranged in a circle round her. It is now found that it would be better for her if she were riding at anchor. Accordingly the great anchor is cast and the attachments to the buoys are unloosed. But let us further suppose that just as this change is being effected a sudden squall sweeps down upon the ship; most certainly the risks of her drifting are not small! In a somewhat similar way the embryo in its chorionic sac is moored by its general chorionic-decidual attachments; but the fœtus is to be anchored by its placenta, and if a disturbance sweep over the pelvis—a wave of congestion, for instance—during the performance of the delicate readjustment, there can be little cause for wonder if the gestation sac is cast adrift. By the end of the third month the sheet-anchor, the placenta, has got a firm hold and the risk of shipwreck is much lessened.

It is possible to form mistaken notions of the *causes of abortions*. The text-books nearly all give long lists of the causes, divided in different ways into groups, such as maternal and fœtal and paternal causes; and for the purpose of your passing examinations such lists are necessary,—are, at any rate, thought to be necessary. But the young doctor has not been long in practice before he begins to suspect that the lists are not infallible; for he will notice that with one patient an absolutely trifling cause, such as a momentary slip on a polished floor, will with certainty produce an abortion, while another woman may be subjected to really grave traumatisms without there being the slightest indication of any tendency for the uterine contents to escape. As his knowledge grows it will be borne in upon him that there is a very important personal factor, —that one woman has a uterus which apparently expels its contents on the slightest possible provocation, while another has a womb which may be compressed, bruised, lacerated even, with purely negative results. The *aborting coefficient* is to be arrived at by the consideration of the cause in action plus the uterine irritability (as it may be called, for want of a better name). In some cases the cause may be represented by 45, then the uterine irritability will

require to be 55 to lead to abortion; in other cases the uterine irritability may be 95, then a cause represented by 5 will be sufficient to produce the same effect. Of course we cannot fix either factor exactly, but when we are dealing with patients we soon begin to know those with a high degree of uterine irritability and to take altogether different measures to prevent miscarriage with them. It will be more important for you in practice to have an approximate idea of the aborting coefficient in your patient's case than to have a perfect remembrance of all the maternal, fœtal, and paternal causes of abortion which your text-books set forth in such elaborate detail. Keep this in mind and your prognosis will be more accurate, your therapeutics better directed, your prophylaxis more effective, and your surprises less frequent. It will never do you any good in practice to give free permission to a pregnant patient to take a short journey or to have a tooth drawn, and then have to attend her for a threatened or inevitable abortion. With one patient the permission may be perfectly justified; with another it may be almost criminal. What is the aborting coefficient?

We see the effect of the uterine irritability very clearly when it has been decided that it is necessary to *induce abortion* artificially. There is a tendency—and I believe it is in the right direction—to limit this operation more and more; but now and again it is needed, as in cases of hyperemesis gravidarum. Under such circumstances you will find that if you can start uterine action easily you will be able easily to empty completely and quickly the uterine cavity; if you cannot do so you are face to face with one of the most difficult and tedious operations of obstetrics, and if you attempt to hasten the cervical dilatation and the uterine evacuation you may have sadly to admit that the ensuing death was not entirely due to the hyperemesis. With uterine action to aid you the emptying of the uterus becomes a matter of little difficulty; with an inert organ it is both difficult and dangerous.

Experience, then, has taught us something, if not very much, about this uterine irritability. It has also become plain to every observant obstetrician that this state of the uterus, which makes it so easy for it to part with its contents, is present in an exaggerated degree at certain recurring periods during pregnancy. These are the *"menstrual days" in pregnancy,* the times at which, had pregnancy not supervened, menstruation would have taken place. It

may be that at these times there is a more than usual pelvic congestion, it may be that an "œstrous toxin" is then circulating in the blood with a special tendency to excite uterine action; whatever be the cause, there is no doubt that the menstrual period, and especially the third group of menstrual days, is the time in pregnancy when interruption is most liable to occur. This is something definite for us to bear in mind when we are face to face with the problem of the prevention of recurrent abortion.

The specimen which I show you affords a good example of a miscarriage in which uterine irritability must have been almost if not quite absent. It is from a case of *"missed" abortion* which I saw in consultation some years ago. The patient was a multiparous woman who regarded herself as seven months pregnant; but she had felt no movements, her abdomen was not at all distended, neither were there any of the reflex phenomena of pregnancy. The bimanual examination revealed a uterus about the size it has at the third month of gestation; the cervix was tightly closed, and the vagina showed neither the coloration nor the vascularity of pregnancy. When about three months pregnant, according to her reckoning, the patient had had some signs of a miscarriage,—slight pelvic pain and a few drops of discharge,—but these had quickly passed off. As she was not suffering in any way, I advised watchfully waiting the development of events, and hazarded the prediction that the arrival of the full term might bring with it the expulsion of the uterine contents. So it was. Two months later an elongated mass, six centimetres in length by three centimetres in breadth, was expelled; it consisted of the decidual membranes wrapped round a partly mummified fœtus. When, as some one has said, "the gestation clock struck the hour," the uterus was emptied; the chiming of the quarters had not sufficed! Manifestly this patient had an aborting coefficient in which uterine irritability played a very small part, and was represented by a very small figure, even perhaps by a minus quantity.

The question of the proper *treatment* of abortion is not always an easy one. In the first place, there is the case of *threatened abortion,*—the case in which, from the mildness of the symptoms and the closed condition of the os uteri, it is reasonable to hope that requisite measures may prevent the untimely termination of pregnancy. Then, I believe, the great condition to secure is *rest:* com-

plete rest of body, such as is got when the patient is supine in bed, —not the partial rest of the sofa or couch, when the appearance of a friend or of a servant may cause the patient to sit suddenly bolt upright; rest also not for one day or two, but for one week or two, and possibly for longer than that. Rest of mind also is equally necessary. If the pregnancy is to be brought to the term, the maternal mental and emotional condition must be unbroken by perturbation. Rest of the pelvic organs also is essential: it is worse than useless to keep a patient resting all day and allow her husband to occupy the same bed at night. Rest of the uterus also must be obtained; and after all drugs have been tried, it would seem that the profession is coming back again to the old favorite, opium, in one form or another, and in a full dose. But it is always well to see to it that the intestine, and especially the sigmoid flexure, is completely emptied before any such uterine sedative be given. Cases of *missed abortion* I am inclined to treat first as cases of threatened; then, after symptoms have subsided and in the absence of pelvic pain and discharge and of any sign of infection, to await the onset of uterine expulsive efforts, bearing in mind the maxim that it is well to have the uterus for an ally when we are trying to empty that organ. *Inevitable abortions* I have been in the habit of treating in a very definite and very decisive manner: when it has seemed to me that the abortion was not to be prevented, I have dilated the cervix with my finger or with Hegar's dilators, and have cleared out the cavity digitally and washed out with an antiseptic solution. I have never had occasion to use the curette nor have I ever used a pair of abortion-forceps. Possibly I may have leaned rather too much to the method of rapidly and artificially emptying the uterus; it seems to me that the older plan of giving ergot by the mouth and of plugging the vagina with iodoform gauze has its legitimate sphere of usefulness and efficacy. At any rate, this much may safely be said, that it is wise to make sure that the uterus has been thoroughly emptied. An *incomplete abortion* is always a source of future trouble, which may take the form of septic manifestations or of menorrhagia and metrorrhagia; under these circumstances the curette finds its proper sphere and becomes indeed indispensable.

The treatment of *recurrent abortion* is most tedious, and requires great patience on the part both of the mother and of her medical attendant. In fact, if I were asked to name the most im-

portant medicine in the prevention of recurrent abortion, I should answer "patience, frequently repeated and renewed." Along with patience there must be rest, bodily and mental, especially at the menstrual days and more particularly at the second, third, and fourth months. With regard to drugs, there can be no doubt that chlorate of potash in fifteen-grain doses thrice daily has done valuable service in such cases, and I have had satisfactory results from its employment. Of course, if there be the slightest suspicion that the cause of the recurring abortions is syphilis, mercury is indicated at once. Further, it must not be forgotten that some purely local pelvic cause, such as a uterine displacement or fixation, may require to be removed. General morbid states, such as anæmia, cardiac disease, renal inadequacy, and the like, call for the special treatment suitable to them.

Finally, I may perhaps be allowed to say that it has seemed to me that there is a want in our hospital system,—the necessity for some special institution in which cases of recurring abortion, habitual premature labor, habitual fœtal death, hydramnios, and pathological pregnancies in general might be both studied and treated. Such cases are not at present welcome in general hospitals, for there is an objection to turning the wards into maternities; neither are they acceptable to the maternity staff, for they are "not at the full term of pregnancy." There ought, I think, to be some such hospital—it might be called a *"pro-maternity"*—in which the investigation of the morbid states of pregnancy might be carried on and their treatment elaborated and placed upon a sure basis founded upon experience.

Pædiatrics

ON THE ACUTE DILATATIONS OF THE HEART MET WITH DURING CHILDHOOD AND ADOLESCENCE.

BY A. D. BLACKADER, M.D.,

Professor of Pharmacology and Therapeutics and Lecturer on Diseases of Children McGill University; Physician to the Montreal General Hospital, etc.

All readily recognize dilatation associated with hypertrophy, especially when it arises from valvular lesions easily detected by means of their accompanying endocardial murmurs. It is perhaps questionable whether we are sufficiently on the alert for symptoms of a weakened condition of the heart muscle associated with passive dilatation; nevertheless, the recognition of the existence of such a condition when present is of great importance. In the majority of instances acute dilatation would appear to be a consequence of some abnormal condition of the heart wall. Osler speaks of dilatation occurring as a result of either a weakened heart giving way under a normal strain or a normal heart wall giving way under increased strain. Nevertheless, considering the relatively large amount of reserve force present in a normal heart, it must be admitted that a strain which breaks down the resistance of an efficiently nourished heart wall must be great indeed, and it is probable that in most instances in which the cardiac muscle has given way in childhood some defect in its nutrition will be found to be an important predisposing factor.

Dilatation of the heart is most commonly met with at two periods of life,—during adolescence, when the demands of the developing organism impose an increased strain upon the cardiac muscle, often defectively nourished by an impoverished blood; and again in the decadent period of life, when degenerative or atrophic processes make their appearance in the heart muscle,

either as a sequence to changes in the arterial walls or as a result of some previous inflammatory condition. Of the second class, extremely important though they are, this paper will not speak, but will direct attention entirely to the dilatations that are liable to occur during early life and adolescence.

In this latter group the important predisposing factor is the very rapid development which takes place in the size of the heart at puberty. For the first three years of life the heart's growth is rapid and proportionate to that of the body, from the third to the tenth year it fails to maintain its relative weight, but from the eleventh to the fifteenth year growth is again extremely rapid (Holt). Pitt[1] quotes Beneke, who states that the annual increase in the size of the heart between seven years of age and the beginning of puberty is about eight per cent. of its weight, but during the changes which accompany puberty it increases from eighty to one hundred per cent.

In the same paper Pitt says that it is easy to understand how, with such immense developmental changes going on, the heart may prove functionally unequal to the strain which the active life of a rapidly developing boy or girl imposes. At this stage of growth cardiac dyspnœa may arise on slight provocation, and if the strain be further increased the heart wall will yield. Any such tendency is augmented by the existence of a second predisposing factor frequently present at this period of life,—an anæmic and impoverished condition of the blood, due in many instances to faulty hygiene in home and school life. Closely associated with this anæmia is the depressed condition of the nerve-centres, sometimes arising from imperfect nourishment, at other times due to over-excitement and a deficient amount of sleep. Such a neurasthenic state may lead to marked impairment in the tone of both extracardiac and intracardiac nerves.

Similar in some respects to the foregoing in its effects on the heart muscle is the condition of toxæmia which exists in almost all conditions of pyrexia and is specially present during an attack of one of the infectious fevers. Such an attack in childhood may be regarded not only as a predisposing factor, but also as an exciting cause of cardiac dilatation; and many instances are recorded in

[1] British Medical Journal, November 27, 1886.

which, during the course of one of the more grave zymotic fevers, the heart walls have become so seriously impaired both in nutrition and in nerve tone that they have yielded, sometimes quite suddenly, before a slight extra demand made upon their activity. Such a yielding of the heart walls not infrequently takes place in the course of an attack of diphtheria, occasionally at a relatively early period, but more frequently in the later stages of the disease. Lees[1] insists that after a severe attack it is necessary to keep a careful watch on the condition of a child's heart for at least two months.

Acute dilatation, according to this writer, is frequently accompanied by vomiting, and this symptom is, therefore, regarded by him as an important danger signal, especially if along with it there be an increased pallor of the face and a feeble pulse. After the first shock has passed off the urgency of the symptoms may lessen, yet a careful examination may reveal the signs of dilatation. Such patients are in imminent danger and demand most careful attention.

Forchheimer, in an article in the *Jacobi Festschrift,* has directed attention afresh to the occurrence of dilatation in influenza. Frequently the clinical symptoms pointing to such a condition come on early in the course of the illness and are apparently due more to the action of the poison on the nerve-centres than to direct influence upon the heart muscle. With this condition present, the patient will be found lying in a stupor; the skin of a mottled, deeply congested hue; the respirations hurried, and the pulse sometimes slow, more frequently feeble and rapid, and sometimes intermittent. A careful examination reveals no abnormal pulmonary sounds, with the exception perhaps of a few large râles; the outlines of the heart dulness, however, are broadened and the tone of the first sound is impaired; the urine is normal. These symptoms may lessen greatly in their severity in from forty-eight to seventy-two hours, or more definite indications of weakness of the cardiac muscle may develop and assume an alarming character, especially if any pulmonary complication sets in. A distressing paroxysmal cough may sometimes do much to aggravate this condition. In some instances minor degrees of cardiac dilatation may persist for

[1] British Medical Journal, January 5, 1901.

many weeks after an attack of influenza is over, and call for watchfulness lest over-fatigue do serious and permanent injury.

The occurrence of dilatation in severe attacks of typhoid fever is a matter of common observation. The tendency to its development in scarlatina is greatly increased by the presence of any renal complication; instances of such a condition are probably familiar to all. In rheumatic fever in children acute dilatation is very liable to occur. Lees [1] states that even in the most subacute attacks some dilatation of the heart is, in his experience, invariably present, but with the passing off of the rheumatic condition this dilatation lessens and the heart muscle resumes its normal tone. That such dilatation may occur not infrequently will probably be admitted by all, but that it is invariably present repeated physical examinations by careful observers fail to verify. The following is an illustrative case which came into the wards of the Montreal General Hospital a few weeks ago.

H. E., aged fourteen, entered the hospital on April 20, 1901. His previous history was unimportant. He had been taken ill with severe pain in the left side on April 16, and on the following day pain in the knees developed. He took to his bed complaining of weakness, pain, and some dyspnœa. He was a fairly nourished lad, with lips and cheeks of slightly cyanotic hue. There were pain, redness, and swelling over the joint of the right great toe, over the astragaloscaphoid articulation, and in both knees. The pulse was small and feeble; the cardiac impulse was noted as in the nipple-line and was feeble and diffuse; its vertical dulness commenced at the upper border of the third rib and its transverse dulness one and a quarter inches to the right of the middle line, extending to the left as far as the nipple-line. A soft systolic murmur was heard at the apex, the second pulmonary sound was accentuated, and a soft systolic murmur was also heard over the pulmonary cartilage.

Under treatment the rheumatic symptoms rapidly improved, and with absolute rest the transverse dulness of the heart diminished. On April 30 it was noted that the heart dulness began at the third space above and transversely at the right border of the sternum, extending to just inside the nipple-line. On May 3 the

---

[1] Loc. cit.

vertical dulness commenced at the fourth rib; the transverse began at the middle of the sternum and extended to just within the nipple-line. The systolic murmur at the apex was still present and the first sound was accentuated over the pulmonary. On May 18 the area of cardiac dulness was almost normal.

An interesting fact, stated by Lees, is that, although dilatation is far more common in rheumatism than in either influenza or diphtheria, it is much less dangerous. This difference is due apparently to a difference in the action of the several toxins on the cardiac muscle. Microscopical examination of sections through the muscle in a rheumatic and in a diphtheritic heart show much less destruction of the muscle fibres in the one than in the other.[1] Nevertheless, it is to be emphasized that in this affection the condition of the heart wall as well as that of the valves demands the careful daily investigation of the attending physician.

Among the directly exciting causes of dilatation in youth we must undoubtedly place too severe or too prolonged exercise of all kinds, especially in running, wrestling, and swimming. An injurious excess in exercise is, I am persuaded, very possible in school-children unless their games are placed under the direction of a skilled instructor. Heart strain is especially liable to occur if severe contests are undertaken without previous training. Numerous instances are on record in which under such circumstances symptoms developed that point unmistakably to an acute dilatation having taken place. It is quite possible that such a dilatation may permanently impair the reserve force of the heart.

Collier,[2] in a paper on the result of severe muscular exercise in adolescence, states that at least two effects may be noticed,—first, owing to the strain thrown upon the air-vesicles, a condition arises which has been termed physiological emphysema; and second, owing to the strain thrown upon the right side of the heart, over-distention of the right ventricle frequently ensues: he adds that, when we remember the enormous changes going on in the bodies of young adolescents and the coincident rapid growth of the heart, we are safe in assuming that at no time throughout what may be called the athletic period of life is the right side of the heart more

[1] British Medical Journal, January 5, 1901, p. 9.
[2] Ibid., February 16, 1901.

liable to injury from over-distention. The danger he considers to be a very real one, and he details several cases coming under his own observation. Not only is the right side of the heart liable to over-distention, but in almost all instances where lads have participated enthusiastically in athletics evidence of hypertrophy of the left ventricle will be present. The apex-beat will be found lower and more to the left, and its impulse will be strong and heaving in character. In explanation Collier quotes Clifford Allbutt, who, in a paper published nearly thirty years ago, showed that the great strain in severe muscular exercise fell on the aorta. In the earlier stages, he says, blood is thrown into the aorta with both increased force and increased frequency, distending it, and necessitating as a consequence a greater propulsive force in the ventricle. This condition, if prolonged or frequently renewed, results in what has been termed physiological hypertrophy. In rapidly growing and poorly nourished adolescents such exercises may give rise to indications of distinct overstrain of the heart.

As an instance of dilatation in which athletic exercises had certainly a considerable share, the following case may be cited.

J. B., aged seventeen, after playing two championship games of hockey and one of basket-ball during the preceding two days, was taken suddenly ill, February 24, 1901, with vomiting, fever, headache, and a feeling of intense prostration. During the past twelvemonth he had grown rapidly. He was a good student and also took a prominent part in the athletic games of his school. For the week previous to the attack he had suffered from symptoms of a mild influenzal character.

When seen by me during the course of the evening, his pulse was feeble, his temperature 104° F., and respirations 24. There were no abnormal pulmonary sounds, but the area of cardiac dulness was distinctly broadened; the apex impulse was diffuse, with its strongest point of impact just outside the nipple-line in the fifth interspace. The first sound was feeble; there were accentuation and reduplication of the second pulmonary.

On the following morning a rash indicative of scarlatina had made its appearance. The disease, fortunately, ran a moderately severe course without other complication than marked weakness in the heart muscle, as evidenced by the physical signs noted above, by a persistently rapid and feeble pulse, and by a tendency to faintness,

which even as late as the third week was experienced by him on attempting to rise in bed. Not until the sixth week was the lad able to sit up in an easy-chair without showing signs of faintness. After this his recovery of strength was more rapid, and at the present date there are no indications of cardiac enlargement. I have warned him, however, not to attempt severe athletic exercise for many years to come.

The changes at puberty are more rapid in girls than in boys, and are more frequently associated with anæmia and an atonic condition of the heart wall. In such girls generally, but especially in those who act as domestic servants and who do a large amount of running up and down stairs, symptoms of breathlessness on exertion with a disturbing amount of palpitation are easily induced, sometimes out of all proportion to the anæmia present. In a large number of these cases indications of dilatation of a greater or less degree will on careful examination be found.

In patients of this age also, more frequently than in those who are older, do we find dilatation as the result of those conditions which alter intracardiac pressure and increase resistance to the outflow of blood from either the right or the left ventricle. Such conditions may be briefly referred to as disturbances in the respiratory system, in the vascular system, and in the urinary system.

It is not necessary in a paper like this to more than refer to the physical signs indicative of cardiac dilatation,—the feeble, diffuse cardiac impulse; the extension of the cardiac dulness sometimes towards the left, always towards the right; the feebleness of the first sound at the apex and its altered character, being shorter and higher pitched; the accentuation, sometimes reduplication, of the pulmonary second sound; the weak, sometimes slow but generally rapid pulse, with a tendency to irregularity and intermittency. Lees emphasizes another sign which would not have been anticipated, but which is usually present,—a marked accentuation of the aortic second sound, even when the radial pulse is extremely feeble. This sign he attributes to tension of the aorta, in his opinion raised by a contraction of the splanchnic arterioles due to the action of the toxins. A more plausible explanation, however, of this very interesting clinical symptom is given by Nicholson,[1] who states that in extreme dilatation the arterial blood-

[1] British Medical Journal, April 13, 1901.

pressure must always be relatively high for the state of the heart and blood-vessels, and the value of this accentuation of the aortic second sound as a symptom depends on its occurrence at a time when, to judge from collateral symptoms, one would least of all expect it. It is to be regarded as an indication that the ventricle is straining every fibre, and that the heart is arriving at a stage when no further response to stimulation is possible. If a little more work is suddenly demanded, syncope occurs. Marked accentuation of the second sound under these conditions is, therefore, to be regarded as a danger-signal of grave significance and demands that the physician shall exercise extreme watchfulness.

Symptoms or complaints in growing children of loss of strength and energy on exertion, followed by a feeling of faintness, or a weak pulse and a desire to lie down, should always lead to careful investigation of the state of the heart wall.

In the treatment of the severer forms of cardiac dilatation, absolute rest in the recumbent position is necessary and should be associated with a nourishing but carefully regulated diet, to prevent over-distention of the stomach by flatulence. In some instances it may be advisable also that the amount of liquids ingested should be reduced to a minimum. No drug has so powerful an effect upon the heart muscle as digitalis, and in these cases its exhibition in full doses is demanded. Strychnine, although possessing a slight action upon the heart muscle, has a more distinct action upon the cardiac nerve-centres and may be employed at the same time as digitalis. In those cases in which accentuation of the aortic sound is present the exhibition of the nitrites would appear to be indicated, since by dilating the superficial systemic capillaries they may lighten the work of the left side of the heart. At the onset of the acute symptoms it may be necessary to have resort to the more diffusible stimulants, ether, ammonia, and alcohol.

Pathology

A CRITICAL ESTIMATE OF THE VALUE OF BACTERIOLOGICAL EXAMINATIONS OF DRINKING WATER, AND OF THE VALUE OF SUCH EXAMINATIONS AS A MEANS OF DIAGNOSIS IN INFECTIOUS DISEASES GENERALLY.

BY B. MEADE BOLTON, M.D.,

Professor of Pathology and Bacteriology, Marion Sims-Beaumont College of Medicine, St. Louis, Mo.

In view of the fact that many laboratories offer to make bacteriological examinations of specimens of drinking water, it may be well to inquire into the value of such examinations apart from scientific interest. Can it be determined by examining a specimen of drinking water whether the supply is wholesome or unwholesome? This is, after all, the only question that interests those who send specimens to the laboratories, and examinations are valueless unless this question can be answered affirmatively. Ofttimes a definite answer is given in perfectly good faith; the examination has been conscientiously made, and the results are interpreted to mean that the water is potable, or the reverse; and no reflection upon the integrity of those who make these examinations is intended by this inquiry into the value of such reports. In fact, it cannot be denied that bacteriological investigations of drinking water are of value in certain directions; but, on the other hand, it must be confessed that the ordinary examinations made on specimens of water sent to laboratories are useless, and inferences drawn from them may lead to serious error. Even where water is sent to the laboratory with careful attention to every detail of taking the specimen and shipping it properly (and this is seldom done), the examination does not furnish evidence upon which to base an opinion as to the potability

of the water. Bacteriological investigation can answer neither of the two questions which are practically always asked, one or both, when a specimen of water is sent to the laboratory. These two questions are, on the one hand, whether pathogenic bacteria are present or no; on the other, if these are not found, whether the specimen shows evidence of pollution,—in other words, whether it is likely that pathogenic bacteria may get into the water. There are no bacteriological methods yet devised that can satisfy either of these demands, and attempts to do so may lead to condemning water that is potable or to pronouncing polluted water safe for use.

In trying to determine the potability of water both direct and indirect evidences of contamination are looked for. The direct evidence is sought for in the presence or absence of specific pathogenic bacteria; the indirect evidence is obtained by ascertaining the total number of bacteria present, irrespective of the species, and also the presence or absence of members of the colon group. The former search, that for the specific pathogenic bacteria, always leaves us in the lurch, and the latter gives insufficient evidence of contamination, on the one hand, or of purity, on the other.

The statement needs no qualification that we are unable as yet to detect the presence of pathogenic bacteria in water, for the only bacterial diseases that are attributed to polluted drinking water by bacteriologists are typhoid fever and Asiatic cholera. Owing to the rarity of the latter disease in most countries, the matter practically resolves itself into a search for the typhoid fever bacillus. As yet we are unable to identify this organism in drinking water, and in the case of cholera Asiatica we are equally powerless. The difficulty as to the typhoid fever bacillus has long been recognized, and arises from the want of specific characteristics of this organism, or rather from the lack of tests that are perfectly satisfactory. There are certain tests, such as the Widal test reversed,—that is to say, taking blood-serum of a person who has or has had typhoid fever and that gives the Widal reaction, and testing the suspected organism with it. His's test[1] is also of value. A reaction that I myself[2] have

[1] His, On a Method of isolating and identifying Bacillus Typhosus, based on a Study of Bacillus Typhosus and Members of the Colon Group in Semi-solid Culture Media, Journal of Experimental Medicine, vol. ii. p. 677.

[2] Bolton, The Effect of Various Metals on Certain Bacteria, International Medical Magazine, December, 1894.

found to be characteristic might also be of use. Also the fermentation test is applicable, as well as certain other tests in cultures, such as the litmus-agar test. But no one feels perfectly sure even after applying all of these tests, leaving out of consideration the element of time required to make them. Competent persons have confessed to being unable to decide; indeed, the more experience one has had the less inclined is he to speak positively. Even where epidemics of typhoid fever have been shown with great probability to be due to contaminated drinking water, repeated search for the typhoid fever bacillus by competent persons has been fruitless. Only recently in an outbreak of typhoid near Göttingen, Germany, this matter was shown very strikingly. Ebstein [1] states that the disease was undoubtedly due to contaminated water, and yet the examination failed to show the presence of the bacilli. Other examples of this kind are not wanting.

The case is much the same in regard to cholera. There are so many organisms that resemble the cholera spirillum that the more these are studied the less inclined the observer is to pronounce positively. With this organism, as with the typhoid fever bacillus, the Pfeiffer's reaction, as in the Widal test, may be applied; but, even when serum from a convalescent from cholera or a guinea-pig treated beforehand can be obtained, and this is not always convenient, the test leaves the most competent observer in doubt. Kohlbrugge [2] has recently emphasized the difficulty of deciding as to the presence of cholera spirilla in water.

If besides typhoid fever and Asiatic cholera there be other diseases that are caused by polluted drinking water, bacteriological examination is not able to decide in any given case whether the water is to blame or not. The public is very prone to attribute all sorts of epidemics and of individual cases of disease to polluted drinking water. Besides specimens sent for examination for typhoid fever, water is sent to bacteriological laboratories to be examined as a possible source of contagion in diarrhœa, dysentery, furunculosis, malaria, indigestion, and skin diseases. In short, those not specially informed are apt to seek, rightly or wrongly, in contaminated drink-

---

[1] Ebstein, Hygiene in Stadt und Dorf, Deutsche med. Wochenschrift, No. 2, January 10, 1901.

[2] Kohlbrugge, Vibrionenstudien, i., Die Ubiquität choleraähnlicher Wasservibrionen, Centralbl. für Bakteriologie, etc., Nos. 21, 22, 1900.

ing water an explanation for all diseases where the etiology is obscure. In some cases the water is suspected where another explanation is much more plausible or even plainly evident. In none of these cases do bacteriological examinations decide the matter.

Turning to consider the matter of deciding upon the potability of water by indirect evidence,—that is, by determining the number of bacteria and the presence or absence of representatives of the colon group,—it will be found equally unsatisfactory. Of course, in itself the presence of a large number of bacteria in drinking water does not make it unfit to drink, any more than would the presence of any other kind of organic matter therein. We can consume large numbers of bacteria without harm to ourselves. Like the higher fungi, some bacteria are harmless and some are poisonous. Many kinds of mushrooms are eaten without harm, but toadstools are noxious. If we were justified in assuming the probability of the presence of pathogenic bacteria when a relatively large number of bacteria of different kind were found, the examination would be of value. This is, however, not usually the case. It might be justifiable to assume this where the water is freshly drawn from a deep well or pump, for the bacteria in such water were probably washed in from the surface, in which case, of course, pathogenic organisms may have been carried in along with the rest. On the other hand, after a period of dry weather, during which there has been no surface washing, the water from a well might show few bacteria, yet the well might be subject to pollution as soon as there is rain. Where water is shipped to any distance, except it be on ice, the number of bacteria present is absolutely without significance, since the water bacteria increase enormously in a very short time at ordinary temperatures. Where it is shipped on ice, there is little or no change in the number of bacteria in transit; but, as already stated, the mere estimation of the number of bacteria is of little or no value, since aside from pollution their number depends upon other factors which are not always controllable.

Opinions based upon the presence or absence of members of the colon group are just as much limited in value as those based upon the whole number of bacteria in the water. Their presence in water has been assumed to indicate that it was polluted with fecal matter, as the colon bacteria are always present in the intestines. This assumption would be warrantable if these bacteria were found only

in the fæces, but such is not the case. The members of this group are ubiquitous, and finding them in water no more indicates that it has been contaminated with fæces than that these organisms got into the intestines from the water. The colon bacilli get into the bowels originally along with the food and drink, for the intestines of the new-born animal contain no bacteria. Of themselves the colon bacteria probably do no harm when taken into the intestines; they only add to the number already there. But even if these organisms are not found in the water, it is not safe to conclude that fecal contamination has not taken place; for they may have been originally present and afterwards destroyed by other organisms in the water. We are, therefore, not justified in pronouncing water unsafe for drinking if we find colon bacteria, nor in pronouncing it safe if we do not find them.

If what has been said above is true, as all who have done much work in this direction will admit, it follows that bacteriological tests of water sent to the laboratory are of very little utility. Even where cultures are made from water immediately at the source of supply, their value must be very limited, and the value decreases in proportion to the time elapsing between the taking of the specimen and the making of the plate cultures. Our inability to determine the potability of water by bacteriological examinations is greatly to be regretted, and, on account of the great importance of the subject, it is to be hoped that in time methods may be perfected which will enable us to do so.

The aid of the bacteriologist is oftener sought to decide this matter than in any other case except in diagnosing diphtheria and tuberculosis, and it would be still more frequently called for if its value should become established. If we can ever by this means decide upon the potability of water as readily and as surely as we can diagnose diphtheria or tuberculosis from specimens sent to the laboratory, it will be a great boon.

But our inability to determine the potability of water from specimens sent to the laboratory should not discourage research along this line, and it does not detract from the value of bacteriological examination of water in other directions. Of these the most important to the public is the determination of the value of methods of purification of water on a large scale and of their efficient working while in operation. It has been shown by bacteriological ex-

aminations that good filters remove from the water practically all bacteria, and that these tests continued after such filters are in operation enable us to determine whether they are properly performing their work. The value of the examination of water for this purpose is very plainly shown in the work at the Lawrence filters, near Boston. These take out practically all the bacteria, or, at any rate, such a large percentage that, if there were any pathogenic germs in the water before filtration, the chances that these are not removed are extremely few; the constant tests made to check the working of the filters constitute a safeguard against infection from this source.

Bacteriological examinations have also shown that deep-ground water is practically free from bacteria, and that this is the purest source of supply. Such water, having passed down from the surface through a thick layer of earth, has been filtered more efficaciously than could be done artificially. Indeed, the large artificial filters are merely imitations of this natural filter. It may be noted, in passing, that deep-ground water often contains lime and iron salts in undesirable quantities, but there are means of overcoming this objection.

Bacteriological tests and experiments with water are of special value in teaching the technique of bacteriology to students. The plating of water, when freshly drawn from different sources of supply, under various conditions of temperature and rainfall, is excellent practice; similar examinations of the same water after it has stood for different lengths of time since it was drawn give an instructive insight into the behavior of the bacteria in water; the intentional introduction of different species of bacteria into water and examinations at intervals to determine what has become of them is also an interesting biological experiment. In short, in many useful ways the study of the bacteria in water can be made to serve for purposes of instruction for students of bacteriology.

To sum up briefly what has been said at length, although we cannot decide as to the potability of a water by bacteriological examination of specimens sent to the laboratory, such examinations are useful in keeping check upon large, public filter plants, in showing the absence of bacteria in deep-ground water, and in teaching the biology of the bacteria to students.

Now let us inquire as to the value of bacteriological examina-

tions in other directions. The general practitioner can hardly keep so thoroughly conversant with the progress of such a specialized subject as bacteriology as always to know just what may reasonably be expected from it, and persons are sometimes disappointed at the inability of the bacteriologist to give the information demanded, when in reality the state of knowledge makes such information impossible. On the other hand, the aid of bacteriology could be employed with profit in some cases where this is as yet not usually done. The statements below, it is hoped, will be useful to those who send preparations to bacteriologists, and enable the senders to judge how far the results reported may be depended upon.

In the present state of our knowledge bacteriological methods of diagnosis are of more or less value in the following diseases: diphtheria and other anginæ, tuberculosis, leprosy, bubonic plague, la grippe, anthrax, glanders, actinomycosis, gonorrhœa, some skin affections, separate abscesses, furunculosis, erysipelas, typhoid fever, cholera, malaria, and hydrophobia, though the two last named are not strictly bacteriological; also in various maladies not affecting man, as hog cholera, swine plague, and rouget du porc, although, as to the latter disease, it has recently been pointed out that human beings are not entirely exempt.[1] This list probably comprises all the disorders in which bacteriological examinations can yield useful information, and a few words of comment with regard to each of them may serve to show that, although in some cases we cannot as yet obtain entirely satisfactory results, the aid of bacteriology might with advantage be oftener sought than is now usually done.

Tests for the diphtheria bacillus are now so common and have proved of such value that no special remark about them is necessary. But examinations for other organisms in cases of sore throat are not usually demanded, and yet to know the kind of bacteria present in these cases would often be of service in deciding as to their probable gravity and the danger of sequelæ. Aside from the diphtheria bacillus, the bacteria most usually found in such cases are the *Streptococcus pyogenes* and the *Staphylococcus pyogenes aureus.* Other organisms, including the colon bacillus, have also been thought to cause anginæ, but none of them as often as the two first mentioned. These may all be associated with the diphtheria

[1] Lubowski, Befunde von Schweinerothlanfbazillen im Stuhle eines ikterischen Kindes, Deutsche med. Wochenschrift, Jahrgang xxvii., No. 8, 1901.

bacillus or with one another, or either may occur alone. It is probable that sore throat due to the *Streptococcus pyogenes,* either alone or associated with other organisms, is a more serious trouble than one wherein this organism is not present. Even in diphtheria itself the presence of the *Streptococcus pyogenes* probably adds to the gravity of the affection more than does the association of other organisms. Moreover, the *Streptococcus pyogenes* is more apt than other pus producers to cause metastatic abscesses in situations near to and remote from the seat of original infection. Again, this organism is to be dreaded because it is probably identical with the streptococcus of erysipelas and is a frequent cause of puerperal infection and endometritis. So in the examination of material from a sore throat, even though no diphtheria bacilli are found, if the *Streptococcus pyogenes* is present it is to be regarded as a serious trouble, and every precaution should be taken to avoid spreading the disease.

On one occasion the writer was consulted in regard to the permissibility of placing a child with sore throat in an orphan asylum. It was stated that if diphtheria bacilli were not found the child would be put in the institution. The cultures from the child's throat showed no diphtheria bacilli, but in spite of this it was urgently recommended that the child be kept out of the asylum until the throat was well, because the streptococcus was found to be the cause of the angina. So in all cases it would be well to inquire of the bacteriologist what organism is present, either accompanying the diphtheria bacillus or alone.

In regard to the examination of sputum in cases of suspected tuberculosis little need be said. It should be borne in mind, however, that one negative result of examination is of little or no value, and that in such a case subsequent specimens should be examined at intervals. It is not safe to base a diagnosis of no tuberculosis upon one or two examinations that fail to reveal the presence of this organism.

Bacteriological diagnosis of leprosy is not often demanded in our latitude, though the writer has been able to confirm the diagnosis in three suspected cases and to reverse it in one case by examinations of sections of the skin.

Glanders and anthrax are readily diagnosed by inoculation of guinea-pigs and by cultures.

The diagnosis of actinomycosis is readily made with the microscope, which should always be employed in abscesses of the jaw. This disease is probably more common than is generally supposed.

In gonorrhœa diagnosis with the microscope is very valuable. The peculiar arrangement of the gonococci inside the leucocytes is characteristic.

As in the case of the anginæ, so also in examinations of the pus from abscesses: the gravity of the process doubtless depends much upon the kind of organism causing the trouble. Streptococcus infection is probably more apt to lead to general infection, or "blood-poisoning," as it is called, than the other pus organisms are; though it must not be forgotten that the *Staphylococcus aureus* also causes osteomyelitis and other metastatic troubles. Indeed, all the pus producers may cause more or less general infection, but it is probably true that the streptococcus is most to be dreaded in this respect, particularly as this organism is probably identical with the streptococcus of erysipelas, as has already been stated.

The application of the Widal test to the blood in cases of suspected typhoid fever is frequently useful.

The recent observation that the bacillus of swine erysipelas, *rouget du porc,* Schweinerothlauf, occasionally causes disease in man points to the desirability of having examinations made in all cases of obscure infection. From what we know of the increase of virulence acquired by bacteria in passing through animals, it would not be at all surprising if this organism, which now causes such loss of life among hogs, should assume virulence in man.

The above enumeration probably covers nearly or quite all cases where bacteriological examinations can be relied upon with certainty to aid the clinician. It would, of course, be impracticable to enumerate all the diseases in which such examinations have been uselessly demanded; but it may be well to mention those about which the writer has been more or less frequently consulted. It is impossible at present to diagnose by bacteriological examination scarlet fever, measles, whooping-cough, syphilis, or cancer.

Diseases of the Eye

HERPES OPHTHALMICUS AND ITS COMPLICATIONS.

BY JOHN GRIFFITH, F.R.C.S. (Eng.),

Surgeon to the Royal Westminster Ophthalmic Hospital, London.

Herpes ophthalmicus, or zona ophthalmica, as it is sometimes called, is an eruption of herpes in the area of distribution of the ophthalmic nerve,—the first division of the fifth cranial pair. As this disease is regarded by most authorities as a cutaneous manifestation of a peripheral inflammation of the fifth nerve, one wonders why this title, and not that of *herpes zoster facialis,* was given to it; the reason is obviously that the eruption in most instances is confined to the region innervated by the first or ophthalmic division of that nerve. This curious limitation may be present even when there is positive evidence that the whole fifth nerve is involved in some gross lesion. This anomaly is very difficult to explain, and it has caused much controversy as to the pathology of the affection. Involvement of the second and third divisions of the fifth nerve is also sometimes attended by a cutaneous eruption. This disproves the old vascular theory, recently revived by Abadie, who believes the eruption to be due to vasomotor disturbance, and attributes the limitation of the eruption to the area of distribution of the ophthalmic nerve to disturbance of the sympathetic fibres accompanying the arteries in this region. He points out that the vessels in the area innervated by the maxillary branches of the fifth nerve receive their vasomotor nerves from a different sympathetic source. If the fifth nerve is not the origin of the peripheral eruption, how can the lesions and the anæsthesia of the cornea be explained? An instance of herpes ophthalmicus in which an eruption

appeared in the area supplied by the superior and inferior maxillary nerves as well as in that innervated by the ophthalmic nerve has recently come under my notice.

A coachman, seventy years of age, sought advice last November for inflammation of the right eye. The eye was very red and there was an eruption over the right half of the face. The first symptom noticed was a dull aching pain in the forehead, which preceded the eruption by about a fortnight. A few days later, and at least a week before the eruption appeared, the right eye became painful and red. The eye had never been inflamed before and vision in both eyes had always been excellent. The eruption followed the course of the supratrochlear and nasal branches of the ophthalmic nerve; besides this, groups of vesicles were seen over the right malar bone, upon the upper lip, and upon the chin. The situation of these three patches pointed to herpes of the temporomalar branch of the superior maxillary nerve, of the labial branches of the infraorbital nerve, and of the mental branch of the inferior dental nerve. No vesicles were discovered in the mouth, and except for the presence of a single vesicle on the conjunctiva the mucous membranes supplied by the fifth nerve were intact. A large patch of vesicles appeared on the right side of the tip of the nose, but the lateral aspect of this organ was free. The right eye was very much congested, the ocular conjunctiva resembling raw beef in appearance; the eyelids were slightly swollen, and a vesicle was seen in the lower *cul-de-sac*. The cornea was cloudy, the upper half most so; on applying fluorescin, numerous green dots and striæ became manifest. The cornea was anæsthetic, and presented a prominent arcus senilis. The pupil was sluggish in action, but dilated fully under atropine. The tension was normal. R.V. $< \frac{6}{60}$ Sn., but fingers could be counted. L.V. $= \frac{6}{12}$ Sn. The left eye appeared normal in every respect. The patient was a temperate man and was apparently in perfect health. The urine was normal. There was no history of venereal disease, of rheumatism, or of gout. The patient had not been laid up with any illness for forty years. Atropine instillations and the application of boric acid fomentations to the eye were prescribed; the eruption was treated with boric acid ointment.

The patient's condition a fortnight later was as follows: the crusts had separated, leaving red scars; the cornea had become almost entirely clear; the pupil was fully dilated; tension was nor-

mal; there was no neuralgia; the eye was still red, but was free from pain. Atropine was discontinued.

Three weeks later it was discovered that iritis had developed. Numerous synechiæ had formed and the ophthalmoscope revealed a quantity of pigment on the capsule of the lens. There were present also a few dots of precipitate upon Descemet's membrane. The vision was, nevertheless, much improved ($\frac{6}{8}$ Sn.), owing, no doubt, to the clearing of the cornea. The iritis was of a quiet, insidious character, and was unattended with pain, though the eye was still very red. The fundi were normal, there being not the slightest trace of papillitis in either eye.

This case is a fairly typical instance of herpes ophthalmicus, although, as already stated, it is unusual to find an eruption in the course of the maxillary divisions of the fifth nerve. The prodromal neuralgia was not characteristic, and so far the patient has escaped the subsequent neuralgic pains, which are apt to be very severe. The nasal nerve was involved, and, as a consequence, the eyeball and the conjunctiva presented inflammatory changes. The conjunctival vessels were much engorged before the appearance of the eruption; this occasionally happens, and instances have been reported in which keratitis, even the interstitial form, has preceded the herpes. As a rule, the corneal lesions manifest themselves simultaneously with the cutaneous eruption. A vesicle is rarely seen on the cornea; what is usually observed is a circumscribed cloudy area, which partly or wholly stains with fluorescin, showing a loss of surface epithelium. In some instances the superficial lesion is not a single uniform patch, but is composed of numerous discrete striæ and punctate dots, as in the case cited. More rarely the keratitis is wholly interstitial and presents no superficial lesions. In most instances the sensitiveness of the cornea is diminished; sometimes it is quite anæsthetic, a condition which greatly increases the liability to corneal lesions. In severe cases there may be an hypopyon-ulcer or the cornea may slough, complications allied in every respect to the lesions present in neuro-paralytic keratitis. Ulcerative keratitis in the course of an attack of herpes is a most troublesome complication, usually continuing some time after the cutaneous trouble has disappeared. It is attended by pain and discomfort, lachrymation, photophobia, etc., even though the sensitiveness of the cornea is dulled. In one case that I recall the patient a year after the

herpes had disappeared was still under treatment for a relapsing ulcerative keratitis which was accompanied by intense hemicrania.

The ocular complication next in frequency to lesions of the cornea is, in my opinion, iritis; in fact, the cornea is seldom involved independently of the iris. In the case described above the iris became inflamed after the keratitis had subsided,—that is to say, the iritis appeared as a *late* complication. This is not unusual; the iritis may develop insidiously, without pain or discomfort, and may be overlooked or be discovered only by accident, as happened in the above instance. Total posterior synechia, with occlusion of the pupil, secondary glaucoma, and loss of sight, may follow. Jonathan Hutchinson, Sen., has drawn attention to the tendency to severe forms of plastic iritis in the course of herpes ophthalmicus, and to his son is due the credit of exposing this late insidious form of iritis, which may seriously threaten the integrity of the eye. Jessop has stated that the serous is the most common form of iritis in this complaint. It is true that keratitis punctata (descemetitis) is frequently seen with and without posterior synechiæ, but the existence of this affection is to be regarded as an indication of cyclitis rather than of iritis. If the pupil be kept dilated by atropine, the tendency to exudation and adhesions will be reduced to a minimum. As keratitis, the corneal affection in which iritis is most likely to develop, is usually treated with atropine, iritis is more often than not prevented. It is probable that iritis would not have developed in the case which I have cited if the atropine prescribed in the early stage had not been discontinued.

Deep-seated troubles in the eye are not common in herpes. Jessop, in an excellent address upon this subject delivered before the Ophthalmological Society of the United Kingdom, states that papillitis has been observed several times. In the cases recorded by himself, however, papillitis was not noted; he no doubt in examining the fundi in these cases experienced the usual difficulty due to the corneal lesions.

Paralytic affections are not infrequently associated with herpes ophthalmicus, especially palsy of the seventh nerve. Facial palsy, contrary to what might be expected, attends this complaint far more commonly than ocular paralyses. If we trace the ophthalmic division of the fifth nerve from the Gasserian ganglion to its distribution, and consider its intimate relationship to the third, fourth, and

sixth cranial nerves in the wall of the cavernous sinus and at the entrance to the orbit through the sphenoidal fissure, it seems remarkable that zona ophthalmica is not more often connected with ocular paralyses. It has been shown that the lesion giving rise to herpes need not necessarily be seated in the ganglion, but may be located at some point in the course of the nerve

Eichhorst has collected eighteen recorded cases in which herpes zoster was associated with facial palsy. Many—not all—were instances of herpes ophthalmicus. He points out the frequency with which the eruption precedes the paralysis, and states that he is aware of only three exceptions to this rule. Howard Murphy published a case of herpes ophthalmicus of the right side associated with left facial palsy. On the left side also there existed hyperæsthesia along all the branches of the fifth nerve. The right ocular conjunctiva was much inflamed and painful from the presence of a single vesicle. The branches of the fifth nerve involved by the herpes were the supra-orbital and temporal divisions. Murphy's case is allied to a very interesting one of crossed paralysis which was shown by Sir Williams Gowers at a post-graduate lecture at Queen's Square Hospital in 1896.

The patient, a groom, forty-six years of age, had been admitted to the hospital suffering from *right* facial palsy, with anæsthesia of nearly the whole area supplied by the *left* fifth nerve, and palsy of its motor division. There was herpes ophthalmicus with alopecia. The distribution of the eruption was peculiar in that it did not reach to the middle line nor extend to the periphery of the area supplied by the supra-orbital nerve. The nasal branch of the ophthalmic nerve was not involved by the herpes. The eye consequently escaped. There was no papillitis. There was a history of the occurrence of neuralgia of the left dental nerves and of those of the fronto-temporal region ten months previous to the patient's admittance. There was marked weakness of the *right* half of the face except over the frontalis muscle. Slight weakness of the right arm was noted, but the leg was normal. The gait was natural; there was no giddiness nor ataxy. The anæsthesia of the left half of the face was complete; there was also anæsthesia of the mucous membrane of the mouth, of the gums, and of the hard palate, reaching to the soft palate on the left side. The left palatoglossal fold was also anæsthetic, and the anterior two-thirds of the left half of the tongue was devoid of the sense of taste. The lesion producing these

symptoms was thought to be a gumma of the roots of the left fifth nerve pressing on the pons and involving the cerebral portion of the right seventh nerve, in spite of the absence of a history of syphilis. Under potassium iodide these nerve-phenomena disappeared, and sensation and motion were completely restored. It is of interest to note that, notwithstanding the fact that the whole fifth nerve was implicated, the herpes was limited to the forehead and scalp.

In connection with this case, mention may be made of the occurrence of zona ophthalmica after the administration of potassium iodide. Jacquet reports an instance of the kind which was accompanied by conjunctivitis and iritis. The case was remarkable in that there was marked tenderness at the point of exit of the facial nerve from the stylomastoid foramen and also along its distribution. The herpes appeared in the course of the ophthalmic division of the fifth nerve, four days after the administration of two grammes of potassium iodide. The patient had taken the drug four years previously, at which time its administration was followed by left facial palsy that lasted six weeks. Two years later the drug was again given, with the development of intercostal neuralgia.

Herpes associated with paralysis of the ocular muscles is very uncommon. Jonathan Hutchinson, Sen., recorded a case of herpes with complete palsy of the third nerve, also one in which partial ptosis developed after the disappearance of the herpes. Isolated paralysis of the sixth nerve has also been observed in conjunction with this complaint. Silcock places on record two most interesting cases of ophthalmoplegia externa with herpes ophthalmicus. In one case the patient, a man fifty-eight years of age, had herpes on the right side, with partial ptosis and almost complete ophthalmoplegia externa. In the second case the patient, a man seventy-nine years of age, had an outbreak of herpes which, as in the first case, was confined to the area innervated by the first division of the fifth nerve. He had complete ophthalmoplegia externa, anæsthesia of the cornea, slight proptosis, and complete ptosis. There was hemorrhage into the anterior chamber and also into the vitreous, with increased intraocular tension. Slight weakness showed itself in the superior rectus muscle of the other eye. This sign associated with proptosis and intraocular hemorrhage suggested to that surgeon the possible existence of thrombosis of the cavernous sinus. He was inclined to look upon the former case also as one due to a lesion in the vicinity of the cavernous sinus or sphenoidal fissure.

A STUDY OF THE EXTERNAL OCULAR SIGNS FOUND IN STATES OF UNCONSCIOUSNESS.

BY WILLIAM T. SHOEMAKER, M.D.,

Assistant Ophthalmologist and a Chief of Eye Clinic to the German Hospital; Dispensary Ophthalmic Surgeon to the Presbyterian Hospital, Philadelphia.

UNCONSCIOUSNESS, the suspension of one of the most important cerebral functions, occurs in the course of many general diseases; it may result from traumatism, or may be induced, purposely or accidentally, by narcotic drugs, anæsthetics, or psychic impressions. However produced, it is the expression of one of three etiological conditions. In the first the brain is affected as a whole, each portion thereof suffering equally from the disturbing influence. In the second a distinct and circumscribed lesion is present; this may, of course, be followed by a general involvement, but the primary attack is local. In the third the unconsciousness is of a psychic nature, such as sometimes occurs in hysteria, hypnotism, protracted sleep, and conditions more or less akin to these.

Under the first heading are included coma due to cerebral anæmia, cerebral congestion, altered and toxic blood states, narcotics, and anæsthetics. More specifically stated, among the diseases and conditions which at some stage may be attended by coma due probably to one of these causes are syncope, the infectious fevers, uræmia, pernicious malaria, diabetes, insolation, asphyxia, acute yellow atrophy of the liver, opium poisoning, chloral poisoning, acute alcoholism, anæsthesia, and electrical injury. Localization, as just stated, is a factor in the second category. Here are included compression of the brain, destruction of cerebral tissue, thrombosis, embolism, and tumor of the brain. In compression of the brain the lesion which causes compression—hemorrhage, serous effusion, neoplasm, or depressed bone—may be situated anywhere within the cranium. Destruction of brain tissue may be caused by fracture of the skull, softening from pressure, abscess, or tumor formation. Furthermore, unconsciousness may occur suddenly, the patient

being stricken instantaneously, or the cerebral centres may yield gradually to overpowering influences. Different degrees of unconsciousness are thus produced, ranging from blunted sensibility to deep coma. The conditions to be considered in this paper are those of coma so deep that the patient cannot be aroused even momentarily; so profound that only objective symptoms are available. In these states of insensibility all outward signs, however slight, must be carefully observed and their significance understood, in order that a diagnosis may be intelligently made.

The perfunctory recording of signs is of but little value unless they be properly interpreted, and, *vice versa,* a thorough knowledge of anatomy, physiology, and pathology, to be of practical use, must be complemented by power of acute clinical observation. Coma in all the conditions above enumerated may be accompanied by ocular phenomena, and, although these are characteristic and of certain diagnostic import in comparatively very few cases, a knowledge of them cannot but contribute to our understanding of each individual case. The eyes guard the cerebrospinal system as sentinels; they are to the central nervous system what the pulse is to the circulation: the eye is the pulse of the brain. That nothing may be overlooked, the examination of the patient should be conducted systematically, and attention given successively to the eyelids, the conjunctivæ, both palpebral and ocular, the eyeballs, the cornea, and the pupils. Valuable information may be furnished by each of the parts named, and, if abnormal conditions are present, further information may be gained by noting if such changes are permanent or transitory, unilateral or bilateral. The importance of this last observation can be realized when it is remembered that each eye receives impulses from each side of the brain,—that each cerebral hemisphere influences both eyes. The mechanism may be likened to a four-in-hand, in which each horse is in communication with each hand of the driver; one hand can call forth an associated movement on the part of the horses, but is helpless to control them thoroughly in all their actions.

Passing to a consideration of the signs manifested in different parts of the eyes and their appendages, *the eyelids and conjunctivæ* should be studied first. The eyelids seem to be capable of equilibrium in almost any position: they are equally at rest open, closed, or in an intermediate position. During insensibility the eyelids

are generally closed, less frequently they are partially closed, and seldom, as in catalepsy, wide open. The position they maintain may be in response to central or reflex stimulation or paralysis. The cortical centre for closure of the lids is supposed to be situated in the lower parietal lobule; the cranial nerve supplying the orbicularis palpebrarum muscle, by which the lids are closed, is the seventh or facial, and the levator palpebræ muscle, which raises the upper lid, is innervated by the third or oculo-motor nerve. Eyelids which close actively—that is, which when opened close again by muscular action—indicate irritation, reflex or otherwise, the facial nerve responding to stimulation transmitted through the afferent tract or to direct stimulation in the course of the nerve itself. Eyelids which are actively open—that is, which will not remain closed—are not found in states of coma, but are frequently present in delirium. In compression of the brain, cerebral hemorrhage, and those states which are not, as a rule, attended by exhaustion and general systemic impoverishment, the eyelids are closed and the eyeballs protected; but in the unconsciousness often found in certain stages of the infectious fevers, when the blood is charged with toxic substances and the brain improperly nourished, the eyelids are often half closed and incapable of guarding the cornea; reflex action is abolished, and disease of the cornea readily ensues,—dryness, desiccation, ulceration, and perforation being the gamut through which disease here may run. In hysterical coma the lids are generally semi-closed, but, reflex action not being abolished, the cornea is protected from injury and infection. Convulsive movements *limited* to the eyelids and eyeballs are also sometimes observed in hysterical coma. The position of the eyelids in catalepsy is interesting. In the true cataleptic state they remain wide open; they can, however, be closed, when the patient may pass into a condition of lethargy. On opening the lids in a lighted room, the cataleptic state returns, or opening one eye may produce catalepsy on that side.[1] The lid phenomena found in puerperal eclampsia are also interesting. The lids are first closed; then follow open lids, fixed eyes, and contracted pupils; later, rapid opening and closing of the lids, eyes move from side to side or roll upward; pupils dilate and become insensible to light.[2]

---

[1] Gowers's Nervous Diseases, vol. ii, p. 1031.
[2] Lusk, Science and Art of Midwifery, p. 562.

A lid and conjunctival sign, important when present, is *ecchymosis,* for the understanding of which a brief consideration of the anatomy and blood-supply of the parts may be of service. The arterial supply of the lids and conjunctiva is derived from the ophthalmic, the facial, and a branch of the temporal arteries, sources both intracranial and extracranial. The venous blood returning through the ophthalmic vein flows into the cavernous sinus and through the facial vein into the internal jugular vein. Blood thus leaves the eye by both intracranial and extracranial routes. Dwight[1] says that, besides forming a safety-valve for the brain, the veins of the orbit are so arranged that the blood from the eye may be carried off entirely through the superficial and deep veins of the face. Fracture at the base of the skull often produces ecchymosis of the bulbar or the palpebral conjunctiva, but not of the cutaneous surface of the lids, except perhaps very late. This, as pointed out by R. M. Hodges,[2] is to be explained by the anatomical structure of the upper lid. The aponeurotic-like expansion of the levator palpebræ superioris muscle is firmly attached to the upper border of the tarsus of the upper lid, and also intimately connected with Tenon's capsule at the orbital margin, walling off, as it were, the cutaneous from the conjunctival surface of the lid and the orbital cavity. This aponeurosis and the tarsus are dense, and render extravasation of wandering blood difficult. Blood liberated within the orbit, as by fracture at the base of the skull or of the orbital bones, can readily pass forward under the conjunctiva either of the lids or of the eyeball, but cannot pass the dense barrier interposed between the cutaneous surface of the lid and the conjunctiva. On the other hand, an effusion under the occipitofrontalis muscle or in the temporal region finds its way beneath the cutaneous surface of the lids, but for the same reason cannot pass to the conjunctival surface. Hodges's conclusions are:

1. That an effusion of blood beneath the integuments of the skull, if it does not gravitate backward, often produces an ecchymosis beneath the cutaneous surface of the eyelids, but never under the conjunctiva of the lids or globe.

2. That a blow directly upon the eyeball may give rise to ecchymosis of the conjunctiva, both of the globe and of the lids.

---

[1] Anatomy of the Head, p. 66.

[2] Boston Medical Journal, April 17, 1873.

3. That when fracture of the base of the skull is indicated by ecchymosis, the ecchymosis appears first beneath the conjunctiva of the globe, then beneath the palpebral conjunctiva, and only subsequently, if at all, in the integument of the eyelids.

4. That when the injury has been such as to make a fracture probable, external ecchymosis of the lower lid, and less frequently of the upper lid, is a significant symptom only when it accompanies ecchymosis of the globe or follows it after an interval.

In epilepsy, ecchymosis may also occur from the rupture of a blood-vessel due to extreme muscular exertion and high arterial tension during the convulsion, but is of no diagnostic significance. Extravasation of blood into the orbit, if extensive, may cause proptosis, or, by interfering with the return of venous blood, chemosis of the conjunctiva and œdema of the lids; but, as stated above, the blood in the eye has a double exit, which probably lessens the frequency of these conditions. Very extensive œdema of the lids and conjunctiva is, however, a constant symptom of thrombosis of the cavernous sinuses, but sinus thrombosis rarely, and then only in the later stages, causes coma. When this does happen, the ocular symptoms are likely to be more marked on one side, or change from side to side, a phenomenon which is said to be quite characteristic of thrombosis of the cavernous sinus. In uræmia puffiness of the eyelids is found as a bilateral symptom. Emphysematous swelling of the lids and adjacent tissues, as a rule, denotes traumatism, but not necessarily, for the establishment of communication between the outer air and the parts involved may be caused by ulceration. Injection of the conjunctivæ has some diagnostic significance. This condition is present in alcoholic coma, in chloral poisoning, in epileptic seizures, usually in apoplexy, in cavernous-sinus thrombosis, in meningeal coma, and in the coma of typhoid and other fevers. In coma due to cerebral anæmia the conjunctivæ are pale, and in that of psychic origin they are unaltered. At some stage in the course of acute yellow atrophy of the liver, unconsciousness ensues; the conjunctivæ then share in the general jaundice. In his report [1] of a case of acute yellow atrophy of the liver, G. H. Pearce describes the eye as *"glassy."*

Eyeballs.—Abnormal positions of the eyeballs are to be found

[1] British Medical Journal, November 10, 1900.

as exophthalmos, enophthalmos, conjugate deviation, conjugate paralysis, and squint. Regarding the latter condition care must be taken to exclude its previous existence. Normally, in the position of rest, the eyes are directed forward in parallel or slightly divergent lines. Each eyeball has attached to it six extrinsic muscles, and receives an indirect attachment from a seventh, the levator palpebræ superioris, which is associated with the superior rectus muscle. Fourteen individual muscles are, therefore, capable of influencing, to a greater or less extent, the position of the eyeballs. With each muscle functionally normal, it is impossible for one eye to move independently of the other. They are intimately associated and cannot at will be dissociated, and, as pointed out above, each side of the brain sends nerve stimuli to both eyes. In the conjoint movement of the eyes to either side, the predominant muscles in action are the external rectus of one eye and the internal rectus of the other. The nerve path from the cortex down is as follows: From the cortical centre on one side, through the radiating fibres and internal capsule, crossing to the nucleus of the sixth nerve in the floor of the fourth ventricle on the opposite side of the brain. From this nucleus two sets of fibres start, one forming the abducens nerve, supplying the external rectus muscle of the corresponding eye, the other set crossing to the nucleus of the *third* nerve on the other side of the brain, or the side corresponding to that of the cortical centre in question. From the third nerve nucleus the internal rectus of the eye of that side is innervated. We thus may have, from the right cortex, for instance, stimuli passing to the external rectus of the left eye and the internal rectus of the right eye; in response to the associated action of these muscles, both eyes turn or deviate to the left. The motor path from the cortex to the sixth nerve nucleus is here conductive throughout; but it can be readily understood that, if from some cause the path is no longer open, the associated action of the left external rectus and the right internal rectus cannot take place: they are for this associated movement paralyzed. Naturally enough, the right external and left internal rectus muscles minus their associated opponents predominate, and the eyes turn to the right. Movements of this kind are known as conjugate movements, and are caused by lesions so situated as to affect, directly or indirectly, the transmission of impulses through the sixth nerve nucleus. As first pointed out by Prévost, conjugate

deviation is opposite in direction as the lesion is irritating or destructive. With cerebral lesion, if irritating the eyes look away from the lesion, and if destructive they look towards it. If the lesion is in the pons, the opposite conditions hold.

Swanzy [1] places cerebral lesions in four classes, as follows:

1. Central lesions, situated in the cortex cerebri or between that region and the nuclei of the ocular nerves.

2. Nuclear lesions, affecting the nuclei of nerves in the gray matter around the aqueduct of Sylvius and in the floor of the fourth ventricle.

3. Fascicular or radicular lesions, involving the efferent fibres or roots of the ocular nerves in the crus cerebri or pons after they leave their nuclei, and before they appear on the base of the brain at their apparent origin.

4. Basal lesions, attacking the trunks of nerves at the base of the brain between the pons and the sphenoidal fissure.

He reserves the term "conjugate deviation" for that due to central lesions only, and for the deviation caused by nuclear lesions uses the term "conjugate paralysis." Generally the lesion is one of the sixth nerve nucleus.

Localized or focal lesions situated anywhere in the motor paths on one side of the brain before the fibres have decussated, if irritating, cause spasm or convulsion of certain muscles on the opposite side of the body, or, if destructive, paralysis of these same muscles. In either case the functional disturbance of the body muscles is, of course, opposed to the brain lesion, and, as this muscle disturbance is opposed alike for cerebral and pontine lesions, the direction of the deviation is of service in differentiating lesions in the cortex, radiating fibres, or internal capsule from those in the pons. As, in the unconscious subject, should unilateral convulsion or paralysis of the body muscles and conjugate deviation of the eyes present themselves, we cannot see the lesion, but can see the results thereof, it might perhaps be better to express Prévost's rule in terms of the later, thus (after Swanzy):

Cerebral lesions, destructive: eyes turned away from paralyzed side.

Cerebral lesions, irritative: eyes turned towards convulsed side.

---

[1] Norris and Oliver, System, vol. iv, p. 582.

Pontine lesions, destructive: eyes turned towards paralyzed side.

Pontine lesions, irritative: eyes turned away from convulsed side.

Close to and in intimate relation with the pons are the nuclei of the fifth, sixth, and seventh cranial nerves (and others). It is for this reason that pontine lesions may be quite characteristic, involving these nerves after their fibres have decussated, thus giving rise to the well-known crossed phenomena. The conjugate deviation resulting from pontine lesion is the reverse of that due to cerebral lesion, because the affected sixth nerve nucleus, which, as has been seen, may be considered the station of distribution for this associated movement, is on the same side as the lesion, whereas in cerebral lesion the fibres involved cross over to the sixth nerve nucleus of the opposite side. Again, a lesion in the lower part of the pons would involve the facial nerve corresponding in side to the lesion, giving if destructive a crossed hemiplegia, but if in the upper part of the pons, the fibres of the opposite facial nerve would be involved and the resulting hemiplegia would not differ from that of cerebral origin. The patient's head is often thrown towards one shoulder, in accordance with the mechanical principles governing muscles and their antagonists. With cerebral lesion the turning of the head and the deviation of the eyes would correspond in direction; with pontine lesion the turning of the head would be opposite in direction to the deviation of the eyes.

Conjugate deviation is usually of brief duration, rapidly passing off. Gowers gives two reasons for this: first, it is usually a *distant* or *indirect* symptom, by which is meant one produced by interference with portions of the brain far removed from the actual lesion, in an indirect manner, as, for instance, by pressure or circulatory disturbance; and second, through the vicarious action of the opposite hemisphere, equilibrium is promptly re-established. Swanzy concludes that in an apoplectic seizure it is probable that conjugate deviation is the result of a suspension, for the time, of all the functions of the affected hemisphere. As under such circumstances no stimuli could be transmitted on that side, the effect would be that of a paralyzing or destructive lesion, and the eyes would deviate towards the affected hemisphere or away from the body paralysis. Conjugate deviation is a very frequent sign in the com-

mencement of epileptic seizures. Conjugate deviations may be other than lateral, but they are rarely seen and their causation is not understood. The eyes are frequently rolled upward, or upward and to one side, in hysterical attacks, and also in eclampsia. Together with lateral deviation is often seen nystagmus, which is a rhythmical oscillation of the eyeballs, varying in rapidity, according to Gowers, from sixty to two hundred complete movements per minute. These movements are usually lateral, but may be vertical or rotary, and may for the purposes of this paper be considered as always bilateral. The forward movements are towards the side of the deviation. The disturbance is a central one, and may be symptomatic of diffuse or focal brain disease. Meningitis, meningeal hemorrhage, sinus thrombosis, tumor, apoplexy, or brain softening, all variously situated, may cause nystagmus. As a localizing symptom, therefore, nystagmus has no value. It is often found in the symptom complex of epileptic and uræmic convulsions, but cases in which it is present seem to differ in no way from those in which it does not occur. One eye turned up and the other down is a rare condition sometimes found with lesion of the crura cerebelli. The patient is more often conscious than comatose (Flint).

Another associated movement of the eyeballs is that of convergence. Although not positively settled, it is thought by Knies and others that a single nucleus, situated in the middle line and part of the third nerve group,[1] governs convergence. Involvement of this nucleus in coma can be detected only when the disturbance is an irritating one, causing *excessive* convergence, for if this power is paralyzed we have no means of eliciting the information while the patient is comatose. Excessive convergence may occur in hysteria and is then generally a contracture symptom. Hysterical trance is also sometimes marked by rolling upward of the eyeballs with convergence. All associated movements of the eyes may be found deranged in hysteria; Parinaud believes that hysteria shows a predilection for associated functions in its ocular manifestations.

Exophthalmos may result from causes increasing the bulk of the orbital contents behind the eyeball. Such may be vasomotor paralysis, with over-distention of the many blood-vessels here situated, hemorrhage, tumor, or exudation following inflammation;

[1] Perlia, von Graefe's Archiv für Ophthalmologie, B. xxxv, p. 287.

also disease within the cavernous sinuses, such as thrombosis, which is a frequent cause of protrusion of the eyeball. It may be on one or on both sides, and if unilateral is, like other unilateral ocular signs, indicative of one-sided mischief.

The opposite condition, *enophthalmos,* or recession of the eyeball, may be idiopathic or of traumatic origin. If idiopathic it is usually bilateral. The most important disease in which bilateral enophthalmos is a symptom is Asiatic cholera during the algid stage. Collapse and cyanosis are the prominent general symptoms in this stage, but Flint states that he has known patients to become comatose and die without passing through the stage of collapse. He also speaks of coma which is probably uræmic, ensuing during the stage of reaction. The enophthalmos here is due to the rapid and extensive abstraction of the fluids of the body. Cataract may rapidly form as a result of the same cause. Enophthalmos immediately following an injury is generally indicative of a breach in the supporting fasciæ of the eyeball (Tenon's capsule), often associated with fracture of the orbital bones.[1] Great displacement or dislocation of the eyeball, perhaps even into one of the near-by cavities, as the antrum, denotes extensive fracture of the bones of the orbit.

Pupils.—Every observer, when examining a comatose subject, almost instinctively notes the condition of the pupils, and yet it is unfortunately true that, notwithstanding the many striking phenomena exhibited by the iris, the condition of the pupils is of little value as a localizing sign. They may be found dilated or contracted, under many similar circumstances; likewise they may be equal or unequal, or active or inactive to light. Furthermore, the same case may present different pupillary phenomena in different stages. Notwithstanding this, however, pupillary signs have a very distinct value, even if thereby the localization of lesions is not greatly aided. The reflex arc for pupillary contraction extends from the retina, where the light stimulus is received, through the optic nerve, to the optic chiasm, and through each optic tract to the primary optic ganglia (corpora quadrigemina anteriora, external geniculate body, and optic thalamus) on each side of the brain; thence to each third nerve nucleus (centre for pupillary contraction) and by way

---

[1] W. T. Shoemaker, Annals of Ophthalmology, July, 1900, p. 391.

of the oculomotor nerves to the ciliary ganglia, and thence by way of the ciliary nerves to the sphincter pupillæ muscle of each eye. Active dilatation of the pupil is caused by sympathetic nerve irritation, the dilatator pupillæ muscle being supplied by filaments from the cervical sympathetic nerve and sympathetic fibres from the trigeminus. Oculomotor nerve paralysis causes a passive dilation and sympathetic paralysis causes a passive contraction of the pupil. Reflex action of the iris to light may be disturbed by a lesion situated in the afferent paths,—*i.e.,* from the retina to the primary optic ganglia, inclusive; in the efferent paths,—*i.e.,* from the portion of the third nerve nucleus governing pupillary contraction, inclusive, to the filaments of the ciliary nerve distributed in the sphincter pupillæ; or the lesion may be situated between the primary optic ganglia (corpora quadrigemina) and the third nerve nucleus. Lesions situated in the latter position are known as central. Barring synechiæ, dense corneal opacities, atrophy of the iris, and other mechanical obstructions due to inflammation, light thrown into one eye causes an equal contraction of both pupils, each reflex arc properly functioning. The reaction of the iris of the other eye is known as consensual reaction, and must physiologically ensue, because the light stimulus imparted to the retina of one eye reaches with equal force each side of the brain, and is efferently transmitted with the same intensity to each sphincter pupillæ muscle. Lesion in the afferent path, if situated between the eye and the chiasm, prevents, of course, the transmission of any light stimulus; the eye is blind, the iris inactive to light, and the iris of the sound eye consensually inactive. The pupils are equal in size. Light thrown into the sound eye, however, is followed by a return impulse to each iris, and that of the blind eye thus contracts consensually. Lesion situated in one optic tract, or the primary optic ganglia of one side, causes a very characteristic pupillary phenomenon, which, however, on account of the difficulty experienced in its elicitation, is of less practical value than it would otherwise be. Optic-tract lesions cause lateral or homonymous hemianopsia, in which condition, thus produced, the afferent reflex path for one half of each retina is interrupted. Light thrown upon the blind half of one or the other retina produces no reflex contraction of the pupils, but, if thrown upon the other half, reflex contraction results. This phenomenon is known as hemianopic pupillary inaction, or Wernicke's sign, and,

when present, localizes the lesion between the chiasm and the primary optic ganglia or between the latter and the pupillary contracting centre. Lesion *above* the primary optic ganglia would not produce it, because the arc for pupillary reflexes would remain intact.

Disturbance in the afferent or sensory path, it will be seen, does not cause inequality of the pupils. This is not true when the lesion is situated in the efferent or motor path. Here, barring symmetrical or double lesions, the pupillary phenomena are unilateral. Such are the mydriasis resulting from the use of atropine or a similar drug and the pupillary contraction due to myotics, likewise the pupillary phenomena caused by orbital, basal, or nuclear lesions. Lesions centrally located, or between the primary optic ganglia and the third nerve nucleus, if unilateral, produce hemianopic pupillary inaction, differing, however, from that just noted, in that it is without visual disturbance, because the seat of lesion is well removed from the visual tracts. Wernicke's sign in this case is of theoretical value only. Bilateral central disturbance causes double reflex pupillary inaction, or the Argyll-Robertson pupil.

To summarize, then, total reflex immobility of one pupil may be due to obstruction in the afferent path, provided such obstruction is below the optic chiasm, or to obstruction in the efferent path situated at any point. Hemianopic immobility results from obstruction in the afferent path beyond the chiasm or from obstruction in the path connecting the primary optic ganglia with the third nerve nucleus. If the pupil is immobile for consensual action (light thrown into the other eye, the afferent path for that eye being open), the obstruction must be in the efferent path, or a bilateral one centrally located (Argyll-Robertson pupil, which is a *double* hemianopic pupil). So intricate is this mechanism, and so small is the space within which are contained innumerable nerve fibres and tracts, that it is not to be wondered at that the effects of brain disturbance are often of so little value in locating the lesion. A single intracranial lesion may produce a condition of chaos, greatly widening the breach between theory and practice, a breach which is at all times wide enough.

The pupils in the coma of general systemic disturbance, or in that of psychic origin, are affected equally, if at all. Narcotic poisons cause an equal contraction, asphyxia an equal dilatation of the pupils. Unequal pupils are frequently found in focal brain

diseases; it then becomes necessary to decide which is the normal and which the altered pupil. That pupil is considered the more normal which is functionally more active. The pupils in cerebral concussion may be dilated or contracted, freely active to light, sluggishly so, or fixed. Cerebral compression is more often marked by fixed or sluggish pupils and pupillary inequality. Sinus thrombosis, with the exception of that of the cavernous sinus, rarely affects primarily the pupils.[1] In cerebral apoplexy the pupils are usually at first contracted, later often in the midway position, fixed or sluggish, and frequently unequal. Hemorrhage into the pons is attended by strongly contracted pupils, and quite characteristic of lesion in the cerebral peduncles is motor and sensory paralysis on the side opposite to the lesion, with third-nerve paralysis on the same side (Gowers). George W. Callender, in his article on the "Anatomy of Brain Shock,"[2] in which he studies one hundred fatal cases of brain disease or injury, concludes that in certain cases an absolutely dilated and fixed pupil is connected with disease or injury about the course of the cerebral blood-vessels, while a contracted and fixed pupil is often met with when blood is poured out into or when disease is present in the tissue of the brain. He further concludes that no reliance can be placed upon the condition of the pupils as symptomatic of brain injury, except perhaps in their slow action or in the absence of their reaction to light. In twenty-seven cases of fracture of the bones of the head, the pupils were dilated, but not widely, in twenty-one; in eighteen they were dilated and fixed; in three they acted slowly and in six freely to light. In the majority of cases the pupils were fixed midway between dilatation and contraction. Charles J. Evans, in reporting forty cases of head injury treated in the Hull General Infirmary from 1858 to 1863,[3] says very little reliance can be placed on the condition of the pupils; in some cases they are natural, in others one is contracted and the other dilated, in others again both are rather contracted; but undoubtedly the most common condition of all is that of dilatation, though this may vary in degree during the course of treatment. In his tabulated cases dilatation was by far the most frequent condition. He concludes that there seems to be

[1] Macewen, Pyogenic Diseases of the Brain, p. 146.
[2] St. Bartholomew's Hospital Reports, vol. iii.
[3] Ibid.

no evidence to show that a certain variation in their condition is sufficiently constant to characterize an independent state of the contents of the skull, as, for instance, concussion, compression, hemorrhage, or inflammation. Many authorities maintain that in profound alcoholic coma the pupils are dilated. William Macewen, on the other hand, states that the pupils are contracted, and dilate when efforts are made to arouse the patient, without other signs of consciousness returning; in five or ten minutes they again contract (Finlayson). In hysterical coma the pupils are dilated but are freely responsive to light. The pupils, as shown by Dr. W. W. Keen, dilate during violent muscular exertion, and remain in this position, irresponsive to light stimulus, so long as the muscular exertion continues. During an hysterical convulsion, therefore, the pupils may, for this reason, be inactive to light. In epileptic seizures the pupils vary as to size, but are equal; they may be active or inactive to light, but, if active, are sluggishly so. The most common condition is that of stable mydriasis. Hippus, a rhythmical contraction and dilatation of the pupils independent of variation in the intensity of illumination, is sometimes observed. Ordinary uræmic coma and diabetic coma are, as a rule, marked by dilated and sluggishly acting pupils; but this is not a constant symptom: the pupils sometimes present nothing abnormal. The pupillary condition in puerperal eclampsia, as described by Lusk, has been noted above. H. C. Wood, in a paper on "Thermic Fever, or Sunstroke," states that the pupils in insolation are generally dilated, but at times are contracted, and that their activity to light is greatly diminished or lost. Different degrees of contraction or dilatation were sometimes found to follow one another in the same case at different stages.

The effects of administered anæsthetics on the pupils need not be discussed here. Unconsciousness thus produced is almost always intentional, and the nature of the case precludes the existence of doubt as to diagnosis. It should always be borne in mind, however, that during the administration of ether or chloroform, when the anæsthesia is profound, a rapid, full dilatation of the pupils is a sign of impending danger, and, especially in the case of chloroform anæsthesia, generally immediately precedes death.

Reference to a number of the most recent text-books fails to elicit any special information concerning the ocular symptoms found in the comatose form of pernicious malaria.

Electricity, whether as lightning stroke or artificial currents from dynamos, live wires, etc., may produce unconsciousness lasting from a few seconds to a number of hours. Case 30, collected by Tidy,[1] after being struck by lightning recovered consciousness in twenty-four hours. So irregular and uncertain is electricity in its behavior, and so capricious in its selection of points and modes of attack, that no constant symptoms or lesions are to be found in those struck by lightning or injured by artificial currents. Review of a number of reported cases of lightning stroke shows superficial burning and destruction of hairs to have occurred frequently. The eyebrows and eyelashes have been lost in this manner. The pupils are generally dilated and insensible to light. In Tidy's collection of fifty-four cases of lightning stroke the pupils were thus noted in six cases; in one case they were contracted; in the remaining cases the pupillary condition was not stated. This author states that he has seen the pupil contracted on the side of the shock and dilated on the opposite side. A case of lightning stroke is reported[2] in which there were unconsciousness and dilated pupils, but the irides were *active* to light. By far the most constant pupillary condition to be found after severe electrical injury is full dilatation with insensibility to light.

Cataract may result from lightning stroke, but its occurrence is sufficiently remote to place it beyond the scope of this paper.

[1] Legal Medicine, part 1, p. 516.
[2] Medical Gazette, vol. xiv, p. 654.

Laryngology

A SUGGESTION CONCERNING UVULOTOMY; NITROUS OXIDE AND ETHER ANÆSTHESIA FOR TONSILLOTOMY AND ADENOTOMY; ADRENALIN.

A CLINICAL LECTURE DELIVERED AT NORTHWESTERN UNIVERSITY MEDICAL SCHOOL, CHICAGO.

BY W. E. CASSELBERRY, M.D.,
Professor of Laryngology and Rhinology.

A SUGGESTION CONCERNING UVULOTOMY.

Chronic elongation of the uvula and relaxation of the soft palate, features of chronic pharyngitis, nasopharyngitis, and rhinitis, are in part secondary to these conditions and in part the conjoined effect of identical causes. The etiology includes recurrent acute attacks of rhinopharyngitis, contiguous tonsil disease, nasal stenosis, tobacco irritation, and chronic pharyngitis incidental to digestive derangement and nutritional disorders, such as rheumatism and gout. A complexity of causes is often operative in the same case.

The hypernutrition which affects the uvula and velum, like that of the posterior pharyngeal wall, has its origin in persistent hyperæmia. Congestion leads to an exudation of leucocytes and a proliferation of the connective-tissue cells of the submucosa. It excites hypersecretion, and in turn the "hawking habit" serves in part to maintain congestion. Greville McDonald has called attention to the large number of glands embedded on the posterior surface of the soft palate. In addition to the hyperplasia of the submucosa, it is inferred that constant congestion of the subjacent muscular structures and their peripheral motor nerves, especially the levatores palati and tensores palati, leads to sluggishness of contractil-

ity and an ultimate fixation of the muscular fibres in their relaxed state.

Instead of hypernutrition the paretic palate may be actually thinner than normal, as in association with atrophic pharyngitis and in anæmic emaciated states.

At times the hypernutrition results only in increased length of the uvula itself, its original diameter being approximately maintained, but in other cases, especially with chronic pharyngitis in plethoric persons, the uvula grows thick as well as long. The surplus growth near the tip may consist only of mucous membrane and connective tissue, but when much lengthened, and particularly in the thick variety, fibres of the relaxed and hypertrophied azygos uvulæ muscles are found well down in the elongated uvula, and require to be cut through in making an abscission.

I need not dwell upon the subjective symptoms,—the harassing cough, often paroxysmal, the sense of a foreign body in the throat, with efforts to dislodge it, snoring, and defective speech. The cough is apt to be worse on retiring at night, when the uvula falls against the posterior pharyngeal wall, which has been free from its presence during the day, and recurs in the morning on rising, together with retching and vomiting, when it falls forward on the base of the tongue, which has been free during the night. These symptoms are most disturbing at times of acute exacerbation or increase in sensitiveness of the surrounding parts by a "cold," although sensitive and nervous persons may be at all times annoyed. On the other hand, those of a phlegmatic temperament may fail to perceive even an exaggerated elongation.

In extreme degrees of enfeebled palate speech is plainly defective, resembling that of cleft palate: *g* is substituted for *k*, as *gill* for *kill*, and *d*, *b*, and *s* are difficult to accentuate. The patient "talks through his nose," the postpalatine space remaining too open. This defect should be distinguished from the "dead voice" of adenoid vegetations and nasal obstruction, although the two may be conjoined. Public speakers suffer from throat fatigue by reason of the unconscious extra muscular effort needed to raise the palate to a proper plane in speaking, thus conducing to chronic laryngitis. The singing voice is impaired in a similar way.

Snoring is another annoying symptom, caused by the vibration of the paretic velum while impinging on the base of the tongue.

It is more common during oral respiration, but sometimes occurs with the mouth closed.

Treatment.—The propriety of treating relaxation and elongation of the velum from an etiologic stand-point is admitted. Obstructive conditions of the nose should be remedied, "adenoids" removed, hypertrophied tonsils abscised, and chronic pharyngitis relieved by cessation of the local, gastro-intestinal, or constitutional irritations which have established it; tobacco should be interdicted, the diet regulated, and the excretion of uric acid products hastened. In addition local medicinal and surgical measures may be utilized to cause reabsorption or destruction of circumscribed areas of hyperplasia and varicose veins. But all this implies time, persistency, and a control of the patient which in many instances is impracticable. Moreover, even when accomplished, it is often found that the symptoms in part continue; the hypertrophied uvula persists; it remains vulnerable to acute inflammatory attacks, being the first to swell and then to impart its disability to neighboring tissue. Again, with the milder degrees of chronic pharyngitis and paresis of the palate, the elongated uvula is often the major disturbing factor in the throat, and its abscission is all that is necessary to allay the annoying symptoms of which the patient complains.

Hence, first or last, a part of the uvula is amputated, despite an occasional protest, perhaps from one high in the council of laryngology, who would "deprecate such mutilation of a delicate anatomical structure." And there are certain objections to the customary operation, especially when made upon a thick, muscular uvula. The old method consists simply in a square amputation by scissors or uvulotome, an effort being made to slant the cut somewhat upward and backward. The stump which is left is broad, flat, and firm at the end, instead of a rounded tip of yielding consistency. The mucosa retracts, leaving a bundle of sensitive muscular fibres exposed. The healing is prolonged, the swelling considerable, and the after-pain severe. The stump may remain sensitive for several weeks, and in one case, I remember, the patient was conscious of it for months thereafter, complaining of the impression of something in his throat worse than before.

These inconveniences may be largely avoided by the following simple expedient, which doubtless has been previously practised by others, but which I have nowhere seen described. The first step

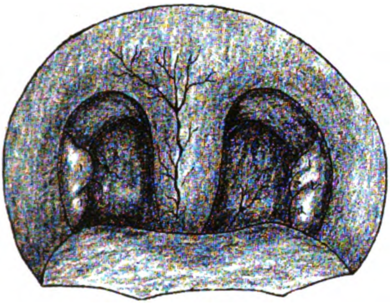


Fig. 1.—Chronic elongation of the uvula.

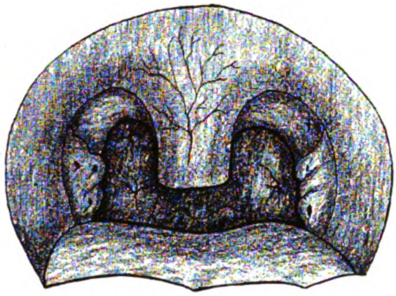


Fig. 2.—Abscission of the uvula by scissors.

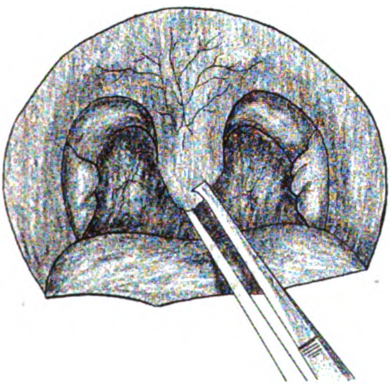


Fig. 3.—Drawing down of central portion of uvula by forceps previous to cutting of muscle.

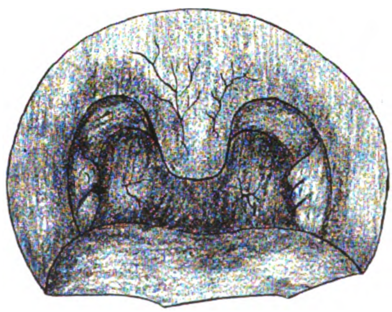


Fig. 4.—Appearance of part at end of operation, the free tip of uvula being well rounded.

in the new operation, as exemplified on this patient, is practically the same as in the old method, except that the uvula is grasped by the retaining forceps a trifle below the exact point of desired abscission. The forceps being locked, the uvula is abscised just above them by scissors. For this the author's uvulotomy scissors answer especially well. The mucous membrane now retracts somewhat, and the next step is to make quickly a second abscission of the protruding bundle of muscular fibres. It is caught by serrated forceps and drawn still farther out from the retracting mucosa, and this time the muscle alone is cut through. The protruding edge of mucous membrane which is left folds around the stump like a circular flap and partially covers its lower end. Thus, cicatrization is hastened, the after-pain and swelling are lessened, and the result is a more naturally rounded, soft-tipped extremity. (Figs. 1, 2, 3, and 4.)

NITROUS OXIDE AND ETHER ANÆSTHESIA FOR TONSILLOTOMY AND ADENOTOMY.

Inhalation of nitrous oxide as a preliminary to ether anæsthesia has been satisfactorily used at St. Bartholomew's and other hospitals in London and at the Roosevelt Hospital and the Hospital for Ruptured and Crippled in New York. Dr. D. H. Galloway has recently reported to the Chicago Medical Society a series of fifty cases of general surgery in which he administered the gas before giving ether. Brown and Kelly, at Baltimore, mention three hundred cases. The purpose of the combination is to hasten unconsciousness, thus lessening the quantity of ether absorbed by from two to four ounces, thereby making ether anæsthesia still safer, especially with regard to elimination by the kidneys. For the same reason, revival is quickened. Incidentally time is saved, disagreeable sensations are obviated, and the subsequent nausea is minimized.

At the institutions named, complicated metallic closed inhalers of the Clover-Hewitt, Ormsby, or Bennett type are employed, through which is passed first nitrous oxide gas, then gradually a mixture of gas and ether, and finally ether alone. Such apparatus is not suitable for throat operations, in which one sometimes wishes the patient to bleed into the inhaler. Dr. A. H. Miller reports that at the Rhode Island Hospital, since June, 1899, the nitrous oxide has been first administered through an ordinary dental inhaler and

then the ether given through an open cone. This is the method which seems best suited for tonsil and adenoid operations.

In this throat clinic we have had much experience with nitrous oxide gas and with nitrous oxide and oxygen as anæsthetics for these operations. I introduced nitrous oxide here for routine use because of its comparative safety, but it has not given complete satisfaction, on account of the haste necessary to complete the combined operation within the forty-five seconds of anæsthesia produced by a single administration of the gas. To gain more time, we have occasionally repeated the gas inhalation, but have felt that this lessens the element of safety. In cases in which more deliberate operating is desirable I have used ether, alone or preceded by the A. C. E. mixture. This is satisfactory except for the usual inconveniences of ether anæsthesia,—time, nausea, and more prolonged recovery. Hence the desirability, if possible, of securing a means of anæsthesia which will allow a little more operating time than nitrous oxide or bromide of ethyl and a quicker recovery than simple ether, increasing meanwhile, rather than sacrificing, the element of comparative safety. In this connection I will review the details of the case just operated before you.

The patient is a poorly nourished boy, aged five years, suffering from hypertrophied faucial tonsils and adenoid vegetations, with bilateral suppurative otitis, rhinitis, and enlarged cervical lymphatic glands. Operation at 10.30 o'clock, Drs. Stubbs and Look assisting. He was wrapped in a sheet, with one arm loose, and held in the lap in the intubation position. The mouth-gag being inserted, the White dental inhaler was closely applied, and after a few whiffs of air the gas was allowed to flow. In one minute, without much struggling, he was anæsthetized, as evidenced by falling of the arm and absence of the conjunctival reflex. As usual in anæsthesia from gas, the face was cyanotic, the pupils contracted, the pulse full and strong, and the respirations deep, regular, and a few seconds later beginning to be stertorous. The gas-inhaler was then withdrawn and an ordinary ether-cone applied. This was made of paper and a towel, open at the tip, in which was placed absorbent cotton so that air would filter through it. On the cotton in the cone about one drachm of ether was placed at a time. At the change from gas to ether there was a momentary lull in respiration, after which the ether was inhaled as comfortably and quietly as

the gas had been. In two minutes more the cyanotic appearance incidental to the nitrous oxide had disappeared, muscular relaxation was still complete, the conjunctival reflex lacking, the laryngeal reflex retained, the pupils contracted, respiration quiet and regular, and the pulse full and strong. The ether cone was now temporarily withdrawn, and the faucial tonsils were abscised one immediately after the other. The child was then tilted forward for the blood to flow from the mouth, the ether cone being reapplied during the actively bleeding period of a couple of minutes. The "adenoids" were then removed by curettes, the patient was again tilted forward for bleeding, a digital exploration made, and the ether cone again applied for two or three minutes. Some small fragments which remained were picked off by forceps, and, as a final step, the adenoid area was scraped with the finger-nail. These details of an operation already familiar to you are mentioned simply to convey an idea of the anæsthesia. It lasted in all about ten minutes, and when finished the boy was already reviving. In five minutes more he could answer questions, and within an hour he was able to leave the institution.

This case alone shows only the adaptability of the gas-ether combination by the open method to the needs of the operation for conjoined adenoid growth and hypertrophy of the tonsils; I have not seen this adaptation previously recorded. It confirms the reasonable expectation of a rapid revival of the patient, for but little ether is required. Of course, it proves nothing regarding comparative safety, the many cases in general surgery already published being drawn upon for inference in this respect, and it merely suggests, rather than demonstrates, an ease of administration, because, as is well known, different cases succumb with varying degrees of resistance to any anæsthetic. It will be followed by other cases, with differing technique and a supplementary report.

ADRENALIN.

All have become familiar with the vessel-constrictor and local ischæmic effect of the extract of suprarenal gland on mucous membranes. It causes the turbinated bodies to shrink in volume, the nasal mucosa to assume a pallid hue, and small vessels to disappear from sight. It stimulates directly the muscular coats of the blood-vessels or their contained ganglia, and when given systemically it

causes, in the same manner, a powerful rise in the arterial pressure, probably assisted also by stimulation of the vasoconstrictor centres. It is a decided cardiac stimulant, particularly when the action of the heart is previously enfeebled, embarrassed, or intermittent. It acts promptly in the resuscitation of animals from chloroform syncope.

A medicament of such decided powers should possess a broad usefulness, but the inconveniences of the preparations heretofore supplied have served to limit its application. The most minute care is necessary to make and maintain the aqueous extract sterile. The development in it of organisms of putrefaction is hindered, but not prevented, by various antiseptics. Hence efforts have been made to isolate its active principles. Dubois, Gourfein, and Chittenden all found two bodies, only one of which raises blood-pressure and constricts the vessels. This is insoluble in ninety per cent. alcohol, soluble in water, non-volatile, and non-toxic. Its activity is not destroyed by mineral acids, but is impaired by alkalies. It was named, by S. Frankel, sphygmogenin and, by Wagner, ischæmin. It was supposed by some to be composed of several albumoses, but a similar substance was later classified, by Abel and Crawford, of Johns Hopkins Hospital, as an alkaloid belonging to the pyridine bases, and named epinephrin. Uncertainty seems to exist even yet as to the exact composition, the chemical purity, and the identity of these substances, and they have not been supplied commercially.

Quite recently there has been sent to this throat clinic for trial a derivative, evidently an active principle, isolated by Dr. Jokichi Takamine and named "adrenalin." In substance it is a gray, stable, finely crystalline powder, of slightly alkaline reaction, which I have found to be insoluble in strong alcohol, ether, almond oil, and albolene, and only sparingly soluble in water,—about 1 to 5000. For practical use it is furnished in the form of "adrenalin chloride" dissolved in normal salt solution, 1 to 1000. The active principle acts as a base, uniting with acids to form salts. The adrenalin chloride is more soluble in water, but is not a stable salt in dry form. The adrenalin chloride solution is clear, colorless, odorless, sterile, stable if protected from heat, light, and oxidation, and non-irritating to mucous membranes. When exposed to light for some days in the presence of air, as in a spray-bottle, it undergoes a change which renders the solution pinkish, then brown in color, but

it remains active, at least to a large degree. The change is said to be an oxidation, but light seems to facilitate it. When applied locally the solution exerts identically the same vasoconstrictor influence as the aqueous adrenal extract. Sprayed into the nostrils in the strength of 1 to 10,000 it produces at once a visible change from turgidity to compactness of the turbinated tissue and a decided pallor of the mucous surfaces. In the strength of 1 to 1000 or even 1 to 5000 it has the same power to limit hemorrhage during operations upon spurs and deviations of the septum and in pharyngeal operations. It is equally an aid in the treatment of epistaxis. It may be substituted for cocaine in all cases in which an ischæmic but not a decided anæsthetic effect is desired,—*e.g.,* to facilitate inspection of the deeper recesses of the nasal cavities and to increase access by cleansing solutions. Unlike cocaine, it has little or no cerebral stimulant effect, exciting no desire for more beyond the local relief afforded by it; hence it is unlikely to lead to a habit.

Like cocaine, its retractile effect on vascular tissue is followed by a reaction or subsequent turgescence, which varies in time and degree in accordance with the freedom of application, the extent of previous turgescence, and other conditions. Thus, in acute rhinitis it has acted admirably in certain cases and seemed to aggravate others because of this reaction. It pales the congested mucosa in acute laryngitis and acute tracheitis, affording a corresponding temporary relief to the symptoms and hastening recovery. For this purpose, I have shaken thoroughly together one part of aqueous solution of adrenalin chloride (1 to 1000) and two parts of liquid petrolatum, which mixture can be inhaled through the larynx in the form of a spray. In one case out of several of laryngitis, also, an uncomfortable reaction occurred. It is not chemically incompatible with the commonly used alkaline and antiseptic solutions, and it remains active in such solutions, at least for a time. The adrenalin may be rubbed up with vaseline to form an ointment, or mixed with stearate of zinc, powdered starch, or sugar of milk to make nasal or laryngeal insufflation powders. Its internal and hypodermatic uses present fair fields for future observation.

Miscellaneous

THE PRONUNCIATION AND DEFINITION OF SOME OF THE NEWER MEDICAL WORDS.

BY W. A. NEWMAN DORLAND, M.D.,

Associate in Gynæcology, Philadelphia Polyclinic; Author of the American Illustrated Medical Dictionary, etc.

ACHILLOBURSITIS (ak-il″o-bur-si′tis). Inflammation and thickening of the bursæ which surround the tendo Achillis, especially of the anterior bursa.

ACHROACYTOSIS (ak-ro-as-it-o′sis). Excessive development of the colorless lymph-cells; a condition noted in Mikulicz's disease.

ACOIN (ak-o′in). A white powder derived from guanin, and used as a local anæsthetic and bactericide.

ACTOL (ak′tol). $AgC_3H_5O_3 + H_2O$; silver lactate; a white tasteless powder, soluble in twenty parts of water, and used as an antiseptic in infectious diseases and gonorrhœa.

ADAMANTOBLAST (ad-am-an′to-blast). An enamel-cell; one of the cells from which the enamel of the teeth is developed; an ameloblast.

ADENASTHENIA (ad-en-as-the′ne-ah, ad-en-as-then-i′ah). Deficient glandular activity.

ADENOTOME (ad′en-o-tōm). An instrument for incising glands.

AEROCELE (a′er-o-sēl). A tumor formed by air filling an adventitious pouch, such as a laryngocele or tracheocele.

AEROPOROTOMY (a″er-o-po-rot′o-me). The operation of admitting air into the air-passages, as by intubation or tracheotomy.

ÆSTHESIOBLAST (es-the′ze-o-blast). A ganglioblast. See ESTHESIOBLAST.

AGGLUTININ (ag-lu′tin-in). A hypothetic principle believed to cause the agglutination or clumping of bacilli in typhoid and other cultures; paralysin.

AGRAFFE (ah-graf′) [French]. An instrument for holding the edges of the wound together in the operation for harelip.

AIROL (a-ir-ol). $BiC_6H_2(OH)_4COOI$; bismuth oxyiodogallate; a green antiseptic powder used externally as an antiseptic and anti-gonorrhœal in the form of a ten per cent. ointment or emulsion.

ALEXOCYTE (al-eks'o-sīt). A protective cell of the animal organism secreting alexins or antitoxins; a microbicide cell.

ALGIOMOTOR (al-je-o-mo'tor). Producing painful movements, such as spasm or dysperistalsis.

ALGIOMUSCULAR (al-je-o-mus'ku-lar). Causing painful muscular movements.

ALGOLAGNIA (al-go-lag'ne-ah). Abnormal and distorted activity of sexual impulse towards persons of the opposite sex; this term includes sadism, masochism, etc.

ALGOPSYCHALIA (al-go-si-ka'le-ah). A condition of melancholia with perverted imaginary perceptions of sounds and sights which cause dread, despair, and inclination to suicide; psychoalgalia.

ALLACHÆSTHESIA, ALLACHESTHESIA (al-ak-es-the'ze-ah). The sensation of touch experienced at a point remote from the point touched.

ALLONGEMENT (al-onzh-maw') [French]. Elongation; especially any procedure for elongating a uterine tumor after it has been severed from its connections, so as to admit of its extraction.

ALLOXIN (al-oks'in). Any one of a class of basic substances derived from the nuclein of cell-nuclei, and on oxidation producing uric acid. Xanthin, guanin, adenin, and hypoxanthin are alloxins.

ALLOXUR-BODIES (al-oks'ur). Compounds of uric acid and any one of the alloxins. They are excreted by the urine in certain conditions, but their exact origin is as yet uncertain.

ALSOL (al'sol). Aluminum acetotartrate, prepared by mixing five parts of basic aluminum acetate with three parts of tartaric acid and dissolving in water. This is dried, redissolved, and precipitated with alcohol. It is used as a substitute for carbolic acid, corrosive sublimate, and potassium chlorate, as an astringent and disinfectant, in a one-half to one per cent. solution.

AMPHIARKYOCHROME (am-fe-ahr'ke-o-krōm). A nerve-cell the stainable portion of whose body is a pale net-work, of which the nodal points are joined by a readily and intensely stainable net-work.

AMPULLITIS (am-pul-li'tis). Inflammation of an ampulla, especially of the ampulla of the vas deferens.

ANAXON, ANAXONE (an-aks'ōn). A neuron, or nerve-cell, which appears to be devoid of axis-cylinder processes.

ANECTASIN (an-ek'tas-in). A substance produced by bacteria, which has an effect on the vasomotor nerves opposite to that of ectasin.

ANESIN (an'es-in). A synthetic compound recommended as an hypnotic and local anæsthetic. Dose, from seven to fifteen grains; locally it is used in a one per cent. solution.

ANGIOCARDIOKINETIC (an''je-o-kahr''de-o-kin-et'ik.) 1. Affecting the motions of the heart and blood-vessels. 2. Any agent so acting.

ANGIOLIPOMA (an''je-o-lip-o'mah). An angioma containing fatty tissue.

ANGIONEURECTOMY (an''je-o-nu-rek'to-me). Excision of vessels and nerves; especially the operation of resecting all the elements of the spermatic cord, except the vas deferens with its artery and vein, for the cure of enlarged prostate.

ANGIONEURŒDEMA, ANGIONEUREDEMA (an''je-o-nu-re-de'mah). A swelling of the skin or surface due to some vasomotor neurosis.

ANGIOSCLEROSIS (an''je-o-skle-ro'sis). Hardening of the walls of the blood-vessels; a combined sclerosis of the arteries, veins, and capillaries.

ANGIOTELECTASIS (an''je-o-tel-ek'tas-is). Dilatation of the capillary vessels and the minute arteries and veins.

ANGIOTOME (an'je-o-tōm). 1. A vascular segment; any one of the segments of the vascular system of the embryo. 2. A knife for dividing vessels.

ANGIOTRIBE (an'je-o-trīb). Strong forceps in which pressure is exercised by means of a screw, used for crushing tissue containing an artery, in order to close the vessel and prevent hemorrhage.

ANGIOTRIPSY (an'je-o-trip-se). The production of hæmostasis by means of the angiotribe.

ANHEDONIA (an-hed-o'ne-ah). Total loss of feeling of pleasure in acts that normally give pleasure.

ANILIPYRIN (an-il-ip-i'rin). A preparation of one part of acetanilid with two parts of antipyrin, used in the treatment of rheumatism and influenza. Dose, from five to fifteen grains.

ANISOCHROMATIC (an-i''so-kro-mat'ik). Not of the same color throughout; a term applied to solutions used for testing color-blindness, containing two pigments which are distinguished by both the normal and the color-blind eye.

ANTIABRIN (an-te-a'brin). An antitoxin produced in the blood after the exhibition of abrin.

ANTIARSENIN (an-te-ahr'sen-in). A non-arsenical substance developed in the body by immunizing doses of arsenous acid.

ANTIARTHRIN (an-te-ahr'thrin). A brownish powder consisting of salicin with roasted horse-chestnut added to disguise the taste. It is used in the uric-acid diathesis in doses of fifteen grains.

ANTIBACTERIN (an-te-bak'ter-in). A pale-yellow liquid used in tuberculosis by inhalation. It is said to contain boric acid, a solution of ferric chloride, and spirit of chloric ether.

ANTIBODIES (an'te-bod-ēz). Glabrificins; constituents of the blood and tissue-juices of animals rendered immune by inoculation. They act on the disease-bacteria and make them amenable to the action of the alexins.

ANTIDIPHTHERIN (an-te-dif'ther-in). A derivative from cultures of the diphtheria bacillus, used against diphtheria.

ANTILYSSIN (an-te-lis'in). A substance formed in the blood of an animal immunized against a disease, which neutralizes the lyssins produced by the bacteria of the disease, so that the alexins are able to destroy the bacteria.

ANTINOSIN (an-te-no'sin). Tetraiodophenolphthalein; a greenish-blue powder having a faint odor of iodine. It is a compound of sodium and nosophen, and is used as an external antiseptic.

ANTIPHTHISIN (an-tif'this-in). Sozalbumose; an extractive from cultures of tubercle-bacilli, containing one-half per cent. of kresol. It is used in the treatment of phthisis.

ANTIPYONIN (an-te-pi'o-nin). Sodium tetraborate or polyborate; a smooth white powder, soluble in water, and non-caustic; used in ophthalmology.

ANTITUSSIN (an-te-tus'in). $(C_6H_4F)_2$; difluor-diphenyl; a white crystalline powder, used as a disinfectant vulnerary and also in whooping-cough.

ANTROCELE (an'tro-sēl). An accumulation of fluid in the maxillary antrum.

APHEMÆSTHESIA, APHEMESTHESIA (ah″fe-mes-the'ze-ah). Failure of word-perception; word-blindness and word-deafness.

APOLYSIN (ap-ol'is-in). $C_6H_4(OC_2H_5)NH.C_8H_7O_6$; monoparaphenatidincitric acid; a white, crystalline compound, soluble in hot water and alcohol, and used as an analgesic and antipyretic. Dose, from five to thirty grains.

AREVAREVA (ah-ra″vah-ra'vah) [Polynesian]. A severe form of skin-disease, with general decay of the vital powers, said to be due to excessive use of kava.

ARGENTAMIN (ahr-jent-am'in). A colorless liquid consisting of a solution of silver phosphate in an aqueous solution of ethylenediamin. It is used in gonorrhœa and ophthalmology in a 1:4000 solution.

ARGENTOL (ahr'jen-tol). $C_9H_5N.OHSO_3Ag$; quinaseptol silver; a compound used as a local astringent and antiseptic in surgery and for gonorrhœa.

ARKYOCHROME (ahr′ke-o-krōm). Any nerve-cell in which the chromatic substance arranges itself in rows or in the form of a network.

ARKYOSTICHOCHROME (ahr″ke-o-stik′o-krōm). Any nerve-cell which is both an arkyochrome and a stichochrome.

ASPIRIN (as′pir-in). Acetyl salicylic acid; a substance used like sodium salicylate as a remedy for rheumatism. Dose, fifteen grains.

ATTICOTOMY (at-ik-ot′o-me). The surgical opening of the attic of the labyrinth.

AVENOLITH (av-e′no-lith). An intestinal calculus or enterolith formed around a grain of oats. It is said to be common in Scotland.

AXITE (aks′ēt). Any one of the terminal filaments of an axis-cylinder.

AXODENDRITE (aks-o-den′drīt). One of the non-medullated side-fibrils given off from an axis-cylinder process of a nerve-cell.

AXOFUGAL (aks-of′u-gal). Directed away from an axon or axis-cylinder process.

AXON (aks′ōn). 1. The body-axis. 2. An axis-cylinder process of a nerve-cell.

AXOPETAL (aks-op′et-al). Directed or proceeding towards an axon or axis-cylinder process.

AXOSPONGIUM (aks-o-spun′je-um). The mesh-work structure comprising the substance of the axis-cylinder of a nerve-cell.

BACILLEMIA (bas-il-e′me-ah). The presence of bacilli in the blood.

BACILLOPHOBIA (bas″il-o-fo′be-ah). A morbid fear of microbes.

BACILLOSIS (bas-il-o′sis). The state of bacillary infection.

BACTERIOLYSIS (bak″te-re-ol′is-is). The destruction or solution of bacteria within or without the living organism.

BENZENIN, BENZENOBACILLIN (ben-ze′nin, ben-ze″no-bas-il′in). A poison, like etherin, chloroformin, and xylenin, extractable by ether from tubercle-bacilli.

BLOOD-DUST (blud′dust). See HÆMOKONIA.

BOROFORMAL (bo-ro-for′mal). A compound of aluminum hydrate with boric and formic acids, forming white, glossy scales. It is used as an antiseptic and deodorant.

BORSALICYLATE, BORSALYL (bor-sal′is-il-āt, bor-sal′il). A powder containing thirty-two parts of sodium salicylate and twenty-five parts of boric acid, used as an antiseptic and deodorant.

BRENZKATECHINURIA (brentz-kat″ek-in-u′re-ah). The presence of brenzkatechin or alkapton in the urine.

BROMALBUMIN (brōm-al-bu′min). A preparation of bromine (ten per cent.) and albumin, used in epilepsy.

BROMATOXISM (bro-mat-oks'izm) [Greek *brōma,* food]. Poisoning by food.

BROMHEMOL (brōm-he'mol). Hemol combined with 2.7 per cent. of bromine. Dose, from fifteen to thirty grains.

BROMOL (bro'mol). $C_6H_2Br_3OH$; tribromphenol; a crystalline antiseptic, soluble in alcohol and ether; used as a disinfectant and caustic. It is also used internally, in doses of from one-tenth to one-third of a grain.

BROMOPHENOL (bro-mo-fe'nol). 1. Bromol. 2. C_6H_7BrOH; a violet-colored, strong-smelling liquid, employed in ointments for erysipelas.

BULPISS (bool'pis). A contagious disease of Nicaragua marked by the development of crops of itching papules which leave black or white patches.

CARDIOKINETIC (kahr"de-o-kin-et'ik). 1. Exciting the heart. 2. A remedy that excites the heart.

CARDIOMETER (kahr-de-om'et-er). An instrument used in estimating the power of the heart's action.

CARDIOPTOSIS (kahr"de-op-to'sis). Downward displacement of the heart.

CARNIFERROL (kar-nif-er'ol). A preparation of meat-peptone and iron, used as a diuretic and stimulant.

CASEIN-PEPTONE (ka"se-in pep'ton). A light-brown powder, soluble in water, and used as a nutrient for convalescents.

CEREBELLIFUGAL (ser"e-bel-if'u-gal). Tending or proceeding from the cerebellum.

CEREBELLIPETAL (ser"e-bel-ip'et-al). Tending or moving towards the cerebellum.

CHEIROKINÆSTHETIC, CHEIROKINESTHETIC (ki"ro-kin-es-thet'ik). Pertaining to the subjective perception of the movements of the hand, especially in writing.

CHOLANGIOSTOMY (ko"lan-je-os'to-me). The formation of a fistula into the gall-bladder.

CHOLANGIOTOMY (ko"lan-je-ot'-o-me). The incision of an intrahepatic bile-duct for the removal of gall-stones.

CHOLECYSTENDYSIS (ko"le-sis-ten'dis-is). The operation of excising a gall-stone from the gall-bladder, followed by suturing the opening in the gall-bladder and anchoring it to the abdominal incision, which is closed over it.

CHOLECYSTENTERORRHAPHY (ko"le-sis-ten-ter-or'ra-fe). The operation of suturing together the gall-bladder and the small intestine in cases of biliary fistula.

Cholecystoduodenostomy (ko-le-sis″to-du-o-den-os′to-me.) The surgical formation of a communication between the gall-bladder and the duodenum.

Cholecysto-ileostomy (ko-le-sis″to-il-e-os′to-me). The establishment of an opening between the gall-bladder and the ileum.

Chroatol (kro′at-ol). $C_{10}H_{16}(HI)_2$; terpeneiodohydrate; a green oily preparation formed by the action of iodine on turpentine, and used externally in skin-diseases.

Chromatolysis (kro-mat-ol′is-is). The solution and disintegration of the chromatin of cell-nuclei.

Chromoparic (kro-mo-par′ik). Producing or giving birth to color, as certain chromogenic bacteria, which secrete a coloring-matter, but which themselves remain colorless.

Chromophoric (kro-mo-for′ik). Bearing color, as certain chromogenic bacteria when the pigment is a component of the bacterial cell itself.

Citrophen (sit′ro-fen). $C_2H_5OC_6H_4NH_2HOCOC_3H_5O(COOH)_2$; paraphenetidin citrate; a white powdery or crystalline, sourish compound, used as an antipyretic and antineuralgic. Dose, from three to fifteen grains.

Cleidotomy (kli-dot′o-me). The operation of dividing the clavicle of the child in difficult labor, in order to permit of the passage of the shoulders.

Collargol (kol-ahr′gol). Colloidal silver; an allotropic form of silver, soluble in water and in albuminous fluids; it is used as a germicide and antiseptic.

Diaminuria (di-am-in-u′re-ah). The presence of diamins in the urine.

Disease, Belz′s. A disease characterized by painless ulcerating papules of the mucous membrane of the lips. Banti′s. Splenic anæmia. Beard′s. Neurasthenia. Cotugno′s. Sciatica. Giovannini′s. A rare nodular disease of the hair, produced by a fungus. Hodara′s. A kind of trichorrhexis nodosa seen in Turkish women. Kahler′s. A constitutional disease marked by the development of round-celled new growths in the bones, a tendency to spontaneous fractures, splenic enlargement, and albumosuria. Mahler′s. Perivaginitis simplex. Mikulicz′s. Chronic enlargement of the lachrymal and salivary glands due to replacement of the glandular tissue by lymph-cells; achroacytosis. Recklinghausen′s. Multiple neurofibromata. Savill′s. Epidemic eczema. Swediaur′s. Inflammation of the calcaneal bursa. Talma′s. Myotonia acquisita.

Ectasin (ek′tas-in). A substance derivable from tuberculin and having the properties of a vasomotor dilator.

ECTHOL (ek'thol). A remedy for erysipelas, prepared from *Echinacea angustifo'lia* and *Thu'ja occidenta'lis.* Dose, one dram.

EMOL (e'mol). An emollient soapy mineral from Perthshire in Scotland; it is used in dermatology.

ENDOSTETHOSCOPE (en-do-steth'o-skōp). A stethoscope passed into the œsophagus for auscultating the heart.

EPARSALGIA (ep-ahr-sal'je-ah). Any disorder or trouble due to overstrain of a part, including hernia, dilatation of the heart, enteroptosis, and hæmoptysis.

EPICONDYLALGIA (ep''e-kon-dil-al'je-ah). Pain in the muscles attached to the epicondyle of the humerus. It is a functional neurosis due to strains on the forearm.

EPINEPHRIN (ep-e-nef'rin). An unstable powder prepared from the suprarenal capsule; it is an astringent and hæmostatic, and is used as an adjuvant in local anæsthesia.

EPITONIC (ep-e-ton'ik). Abnormally tense or tonic; exhibiting an abnormal degree of tension or tone.

EPITOXOID (ep-e-toks'oid). Any toxoid which has less affinity for an antitoxin than the toxin has.

EPITYMPANUM (ep-e-tim'pan-um). The attic.

ERYTHROCYTORRHEXIS (er''ith-ro-si-tor-eks'is). A morphologic change in red blood-corpuscles, consisting in the escape from the corpuscles of round, shining granules and the splitting off of particles; plasmorrhexis.

ERYTHROCYTOSCHISIS (er''ith-ro-si-tos'kis-is). A morphologic change in red blood-corpuscles, in which the corpuscles degenerate into dish-like bodies similar to the blood-platelets; plasmoschisis.

ERYTHROCYTOSIS (er''ith-ro-si-to'sis). The occurrence of the fœtal form of red corpuscles and of nucleated red cells in the lymphatic tissue.

ERYTHROPHIL (er'ith-ro-fil). 1. Easily taking red stains. 2. A cell or other element that is easily stained red.

ESTHESIOBLAST (es-the'ze-o-blast). A ganglioblast; an embryonic cell of the spinal ganglia.

EUCAINE, EUCAIN (u-ka'in). A preparation recommended as a valuable local anæsthetic. It is said to be methyl-benzoyl-tetramethyloxy-piperidin-carboxylic acid methyl ester.

EUCHININ (u-kin'in). $C_2H_5OCO.OC_{20}H_{23}NO_2$; a white crystalline compound formed by the action of ethylchlorocarbonate on quinine. Its properties are like those of quinine, but it produces no disagreeable effect. Dose, from fifteen to thirty grains.

EUDOXIN (u-doks'in). A bismuth salt of nosophen, occurring as a reddish-brown, odorless, antiseptic powder, containing fifty-two per cent. of iodine and fifteen per cent of bismuth. It is used in catarrhal enteritis. Dose, from five to eight grains.

EXOSPLENOPEXY (eks-o-splen'o-peks-e). The operation of suturing the spleen upon the outside of the body or in the wound.

EXTRASYSTOLE (eks-trah-sis'to-le). A heart-contraction occurring earlier than the normal systole; it is due to irritation of the heart-muscle during the diastole.

GASSERECTOMY (gas-ser-ek'to-me). Surgical removal of the Gasserian ganglion.

GASTRALGOKENOSIS (gas-tral-go-ken-o'sis). Paroxysmal gastric pain which is easily relieved by taking food.

GASTRO-ANASTOMOSIS (gas'tro-an-as-to-mo'sis). Gastrogastrostomy, or the formation of an anastomosis between the pyloric and cardiac ends of the stomach, for hour-glass contraction of that viscus.

GASTROPEXY (gas'tro-pek-se). The operation of suturing the stomach to the abdominal wall for the cure of displacement.

GASTROPLASTY (gas'tro-plas-te). A plastic operation on the stomach for correction of deformity, such as hour-glass contraction.

GASTROPLICATION (gas"tro-pli-ka'shun). The surgical cure of a dilated stomach by stitching a fold therein or by the removal of a fold of its walls.

GLABRIFICINS (gla-brif'is-in). See ANTIBODIES.

GONOCOCCOCIDE, GONOCIDE (gon-o-kok'o-sīd, gon'o-sīd). Any agent destructive to the gonococcus.

GUAIAMAR (gwi'am-ahr). $C_6H_4(OCH_3)(OCH_2)CHOH.CH_2OH$; a white crystalline powder used as an intestinal antiseptic and in tuberculosis. Dose, from five to twenty grains.

GUAIAPEROL (gwi-ap'er-ol). $C_5H_{11}N.(C_7H_8O_2)_2$; piperidin guaiacolate; a crystalline agent used in tuberculosis. Dose, from four to twenty grains.

GUAIAQUIN (gwi'ak-win). $C_6H_4O_2CH_3HSO_3.C_{20}H_{24}N_2O_2$; guaiacol bisulphonate of quinine; a yellow crystalline powder combining the antiseptic powers of guaiacol with the antiperiodic action of quinine. It is used internally in enteritis. Dose, from one to five grains.

HAPALONYCHIA (hap"al-o-nik'e-ah). A soft, uncornified condition of the nails.

HÆMATOCYTOLYSIS, HEMATOCYTOLYSIS (hem"at-o-si-tol'is-is). Dissolution and disintegration of blood-corpuscles.

HÆMOKONIA, HEMOKONIA (hem-o-ko'ne-ah). Any one of a very great number of small refractive bodies in the blood, supposed to be fragments of the blood-corpuscles, collectively called the *blood-dust.*

HÆMOL, HEMOL (he'mol). A dark-brown powder prepared from hæmoglobin by deoxidizing with zinc. It is used for anæmia. Dose, from one and one-half to seven and one-half grains.

HEMICRANIECTOMY (hem"e-kra-ne-ek'to-me). Doyen's operation of sectioning the vault of the skull from before backward, near the median line, and forcing the entire side outward, thus exposing half the brain.

HEMIHYPERTONIA (hem"e-hi-per-to'ne-ah). Increased tonicity of the muscles of one side, resulting in tonic contractions; it is sometimes seen after apoplexy.

HEPATICOSTOMY (hep-at-ik-os'to-me). The creation of an artificial opening into the hepatic duct.

HEPATODUODENOSTOMY (hep"at-o-du-o-den-os'to-me). The surgical creation of an opening from the liver into the duodenum.

HEROIN (he-ro'in). $C_{17}H_{17}(O.OC.CH_3)_2.NO$; the diacetic ester of morphine; a white, bitterish, crystalline powder, used as an anodyne and sedative in irritant coughs. Dose, from one-twenty-fourth to one-half grain.

HOLOCAIN (hol-o-ka'in). A crystalline base nearly allied to phenacetine. Its chloride is a local anæsthetic and antiseptic, and is used like cocaine. It is an active convulsant poison.

HYDRARGYROL (hi-drahr'jir-ol). $C_6H_4.OH.SO_3Hg$; mercury paraphenylthionate; used as a substitute for corrosive sublimate. It is a brownish crystalline body having the odor of gingerbread.

HYDROCYSTOMA (hi"dro-sis-to'mah). A cystic disease of the sweat-glands of the face, with lesions resembling boiled sago-grains embedded in the skin.

HYDROGOL (hi'dro-gol). A proprietary agent, said to be an aqueous solution of colloidal silver. It is used for gonorrhœa.

HYDROPARASALPINX (hi"dro-par-ah-sal'pinks). An accumulation of watery fluid in the accessory tubes of the oviduct.

HYPERHEDONIA (hi"per-he-do'ne-ah). Morbid increase of the feeling of pleasure in agreeable acts.

HYPERISOTONIA (hi"per-i-so-to'ne-ah). Marked equality of tone or of tonicity.

HYPERNEPHROMA (hi"per-nef-ro'mah). A tumor derived from suprarenal tissue, either of the gland itself or misplaced in the kidney or elsewhere.

Hyperthermoæsthesia (hi-per-ther″mo-es-the′ze-ah). Abnormal sensitiveness to heat.

Hyperthyroidism (hi-per-thi′roid-ism). Symptoms due to excessive size of the thyroid gland.

Hyphedonia (hip-he-do′ne-ah). Morbid diminution of the feeling of pleasure in acts that normally give pleasure.

Hypnacetin (hip-nas′et-in). $CH_2CO\text{-}NH\text{-}C_8H_4\text{-}OCH_2\text{-}CO\text{-}C_6H_5$; a phenol and acetophenon derivative occurring in transparent crystals. It is hypnotic and antiseptic. Dose, three or four grains.

Hypnalgia (hip-nal′je-ah). Pain that recurs during sleep.

Hypochromatosis (hi″po-kro-mat-o′sis). The gradual fading and disappearance of the nucleus (the chromatin) of a cell.

Hysterocystocleisis (his″ter-o-sis-to-kli′sis). The operation of turning the cervix uteri into the bladder and suturing it to relieve a vesico-utero-vaginal fistula or a uretero-uterine fistula.

Ichthalbin (ik-thal′bin). Ichthyol albuminate; a grayish-brown powder, resulting from a combination of ichthyol and albumin. It is said to represent all the desirable properties of ichthyol without its disagreeable odor. Dose, from fifteen to thirty grains.

Ichthyismus (ik-the-iz′mus). A disease caused by eating stale or poisonous fish.

Ideoglandular (i″de-o-glan′du-lar). Arousing glandular activity as a result of some recollection or thought.

Ideomuscular (i″de-o-mus′ku-lar). Producing involuntary muscular action, due to some ideation, memory, or hallucination.

Ideovascular (i″de-o-vas′ku-lar). Producing some vascular change as a result of a recollection or ideation.

Idiocratic (id-e-o-krat′ik). Marked by peculiarities of constitution or of temperament.

Ikshugandha (ik-shu-gand′ah) [East Indian]. The seeds of the land-caltrop (*Trib′ulus terres′tris*), a European and Asiatic zygophyllaceous plant. The tincture is astringent and is recommended for spermatorrhœa and diseases of the testes. Daily dose, from five to twenty minims.

Ileosigmoidostomy (il″e-o-sig-moid-os′to-me). The surgical creation of an opening between the ileum and the sigmoid flexure.

Inaxon (in-ak′son). A nerve-cell whose axis-cylinder has its arborization at a considerable distance from the cell.

Incudectomy (in-ku-dek′to-me). Excision of the incus.

Indoxyluria (in″doks-il-u′re-ah). The presence of an excess of indoxyl in the urine.

INGUINODYNIA (in″gwin-o-din′e-ah). Pain in the groin; a common symptom of hysteria.

INTIMITIS (in-tim-i′tis). Inflammation of an intima.

INTRAMASTOIDITIS (in″trah-mas-toid-i′tis). Inflammation of the antrum and cells of the mastoid process.

IODO-ALBUMIN (i″o-do-al-bu′min). Any one of a group of artificial iodine compounds resembling true albumins. They are used for myxœdema and goitre.

IODOCAFFEIN (i″o-do-kaf′e-in). A white crystalline compound used in heart-diseases. Dose, from two to fifteen grains.

IODOFORMIN (i″o-do-for′min). $C_6H_{12}N_4.CHI_3$; an odorless substitute for iodoform. It is a white powder, from which seventy per cent. of iodoform is set free by contact with a wound.

IODOTHYMOL (i″o-do-thi′mol). Thymol di-iodide; a substitute for aristol, which it resembles.

ISCHOCHYMIA (is-ko-kim′e-ah). Suppression of gastric digestion; Einhorn's term for dilatation of the stomach, so called because stagnation of the food is the essential symptom of the disease.

ITROL (it′rol). Silver citrate; a light, tasteless powder, slightly soluble in water. It is antiseptic, and is used for gonorrhœa, skin-diseases, and as a dressing for wounds.

KALA-AZAR (kah-lah-az′ar) [native Assam]. An extremely fatal epidemic fever of Assam, resembling chronic malarial fever. It is marked by progressive anæmia, wasting, enlargement of the spleen and liver, and dropsy.

KARYOCHROME (kar′e-o-krōm). Any nerve-cell the nucleus of which is stainable, while the body is not; a nerve-cell in which the stained nucleus is larger than that of a cytochrome.

KINÆSTHESIOMETER (kin″es-the-ze-om′et-er). A device by which to measure or test the muscular sensibility.

KOLPO-URETEROTOMY (kol″po-u-re-ter-ot′o-me). Incision of the ureter through the vagina, for the relief of urethral stricture.

KRESAMIN (kres-am′in). A yellowish, alkaline liquor, containing twenty-five per cent. each of trikresol and ethylendiamin; it is used as an antiseptic and in skin-diseases in from one-tenth to one per cent. solution or a one to five per cent. ointment.

KROMSKOP (krōm′skōp). An apparatus used for the reproduction in colors of photographed natural objects.

KRYOFIN (kri′o-fin). A white crystalline substance derived from paraphenetidin and methyl-glycollic acid, used as an antipyretic and antineuralgic. Dose, from five to eight grains.

LACTASE (lak'tās). A ferment that splits lactose into glucose and galactose.

LARGIN (lahr'jin). A gray powder; a compound of silver and protalbin, containing eleven per cent. of silver; soluble in water, glycerin, and peptones. It is used as a bactericide, especially in gonorrhœa and gastro-intestinal ulcers. Dose, from five to eight grains.

LYSIN (li'sin). 1. A bacterial product which destroys alexins, thus producing a condition favorable to the growth of the bacterium. 2. $C_6H_{14}N_2O_2$; a basic principle derivable from proteids by decomposition.

MACRO-ÆSTHESIA (mak"ro-es-the'ze-ah). A sensation as if all things were larger than they really are.

MACROGAMETE (mak-ro-gam'ēt). The female non-flagellate element in the reproduction of various animal micro-organisms.

MACROGAMETOCYTE (mak"ro-gam-e'to-sīt). Any cell of a kind producing the female reproductive elements of an animal micro-organism.

MARSUPIALIZATION (mahr-su"pe-al-iz-a'shun). The operation of stitching the edges of an ovarian or other cyst to the edges of the abdominal wound so as to leave a pouch. The sac suppurates, fills with granulations, and shrinks.

MASTOIDEOCENTESIS (mas-toi"de-o-sen-te'sis). Paracentesis of the mastoid cells.

MASTOIDOTOMY (mas-toid-ot'o-me). Incision into the antrum or cells of the mastoid bone.

MECKELECTOMY (mek-el-ek'to-me). Surgical removal of Meckel's ganglion.

MELANOPLAKIA (mel"an-o-pla'ke-ah). The formation of pigmented patches on the mucous membrane of the mouth in certain diseases.

MELITOPTYALISM (mel"it-o-ti'al-ism). The secretion of saliva containing glucose.

MENINGISM (men-in'jizm). 1. A condition due to pain in the meningeocortical region of the brain, marked by excitation, followed by depression of the cortex, with vomiting, constipation, and thermic disorders. 2. An hysteric simulation of meningitis.

MESONEURITIS (mes"o-nu-ri'tis). 1. Inflammation of the substance of a nerve. 2. Inflammation of the lymphatics of a nerve.

MESOPHILIC (mes-o-fil'ik). Fond of moderate temperature, as certain bacteria which develop best at the temperature of the body.

METOPANTRALGIA (met"o-pan-tral'je-ah). Pain in the frontal sinuses.

METROCYTE (me'tro-sīt). 1. A mother-cell. 2. A large uninuclear cell containing hæmoglobin; it is supposed to be the mother-cell of the red corpuscles of the blood.

Monochromatophil (mon″o-kro-mat′o-fil). 1. Stainable with only one kind of stain. 2. Any cell or other element that will take only one stain.

Mydrin (mid′rin). A proprietary mydriatic composed of one part of homatropin and one hundred parts of ephedrin. It is a white powder, soluble in water, and used as an evanescent mydriatic.

Mydrol (mid′rol). Iodomethylphenylparazolin; a bitter, soluble, mydriatic powder.

Neuro-epithelioma (nu″ro-ep-ith-e-le-o′mah). A tumor composed of neuro-epithelium.

Nutrose (nu′trōs). Neutral casein-sodium; a dry food-preparation of milk for the use of invalids.

Orphol (or′fol). $(C_{10}H_7O)_3Bi + 3H_2O$; bismuth beta-naphtolate; a basic compound of betanaphtol and bismuth. It is a light-brown, insoluble, aromatic powder, used as an intestinal astringent and antiseptic. Dose, from five to fifteen grains.

Orthoform (or′tho-form). $C_6H_3(OH)(NH_2)COOH_3$; a white crystalline powder, odorless and tasteless, a kind of synthetic cocaine. It is soluble in alcohol and ether, but only slightly so in water; it is used as a local anæsthetic and antiseptic.

Oxyphenacetin (oks″e-fen-as′et-in). A salt occurring as shining leaflets; used as an antirheumatic and antipyretic.

Pachysalpingitis (pak″e-sal-pin-ji′tis). Chronic interstitial inflammation of the muscular coat of the oviduct, producing thickening.

Papillectomy (pap-il-ek′to-me). Removal of one or more engorged papillæ from a kidney for the cure of hæmaturia.

Parachromophoric (par″ah-kro-mo-for′ik). Pervertedly chromophoric; both chromophoric and chromoparic; secreting coloring-matter, but retaining it in the organism.

Paradontitis (par″o-don-ti′tis). Inflammation of the tissues about a tooth.

Phenolid (fen′o-lid). A compound said to contain acetanilid and sodium bicarbonate or sodium salicylate. It is antirheumatic and antineuralgic. Dose, from five to ten grains.

Phenolin (fen′o-lin). An antiseptic solution of kresol in potassium soap.

Phenopyrin (fe-no-pi′rin). An oily liquid composed of phenol and antipyrin in equal parts. It is antiseptic.

Phenosal (fe′no-sal). Phenetidin acetosalicylate; a salt occurring as colorless plates or needles, used as an antipyretic and in acute rheumatism. Dose, from seven to eight grains.

PHENOXIN (fe-noks'in). CCl_4; carbon tetrachloride; a clear, colorless liquid; used locally, hypodermically, or by inhalation, as an anæsthetic.

PHESIN (fe'sin). $C_6H_3.O.C_2H_5SO_3Na.NH.CO.CH_3$; a patented, reddish-brown, powdery sulphoderivative of phenacetine; used as an antipyretic and antineuralgic. Dose, from eight to fifteen grains.

PLASMORRHEXIS (plaz-mor'kis-is). See ERYTHROCYTORRHEXIS.

PLASMOSCHISIS. See ERYTHROCYTOSCHISIS.

PLEUROLITH (plu'ro-lith). A concretion found in the pleura.

PLURICORDONAL (plu-rik-or'do-nal). Noting a form of stellate embryonal cells found in the posterior cornu of the myelon (hitherto found in the embryonic pigeon only).

POLYAXON (pol-e-aks'ōn). A nerve-cell from the horizontal dendrites of which four or more axons or branches are given off.

PROCTOCOLONOSCOPY (prok"to-ko-lon-os'ko-pe). Inspection of the interior of the rectum and lower colon.

PROTARGOL (prōt-ahr'gol). A soluble yellowish powder of silver and an albumose. It is a bactericide, and is used in the treatment of eye-diseases, wounds, and gonorrhœa.

PROTOGEN (pro'to-jen). 1. Any albuminoid substance whose aqueous solution does not coagulate when heated. 2. A food and therapeutic agent derived by the action of formaldehyde upon egg-albumin or serum-albumin.

PSEUDO-ILEUS (su-do-il'e-us). An attack resembling ileus, but due to paralysis of the bowels.

PSEUDO-INFLUENZA (su"do-in-flu-en'zah). An affection resembling influenza, and due to a bacillus resembling, but not identical with, that of true influenza.

PSEUDO-ISOCHROMATIC (su"do-i-so-kro-mat'ik). Seemingly of the same color throughout; applied to solutions for testing color-blindness, containing two pigments which will be distinguished by the normal eye, but not by the color-blind.

PSEUDOJAUNDICE (su-do-jawn'dis). Skin-discoloration caused by blood-changes and not due to liver-disease.

PSILOSIS (si-lo'sis). 1. Falling out of the hair. 2. Sprew.

PSYCHRO-ÆSTHESIA (si"kro-es-the'ze-ah). A state in which a part of the body, though warm, feels cold.

PSYCHROALGIA (si-kro-al'je-ah). Painful psychro-æsthesia.

PSYCHROPHILIC (si-kro-fil'ik). Fond of cold, as certain bacteria which develop best between 15° and 20° C.

PYKNOMORPHOUS (pik-no-mor'fus). Having the stainable elements compactly arranged; a term applied to certain nerve-cells.

PYKNOSIS (pik-no′sis). A thickening; especially degeneration of a cell in which the protoplasmic substance becomes more dense and the cell smaller.

RECTOSTOMY (rek-tos′to-me). The operation of forming a permanent opening into the rectum for the relief of rectal stricture.

RENIPUNCTURE (ren′e-punkt-yūr). Surgical incision or puncture of the capsule of the kidney for the relief of albuminuric pain.

SOZALBUMOSE (soz-al′bu-mōs). See ANTIPHTHISIN.

SPHYRECTOMY (sfi-rek′to-me). Surgical removal of the malleus.

SPLENOHEPATOMEGALY (sple″no-hep″at-o-meg′al-e). Enlargement of the spleen and liver.

SPREW, SPRUE (spru). 1. Thrush. 2. Psilosis; a chronic disease marked by sore mouth, with a raw-looking tongue, indigestion, and diarrhœa. It occurs mostly in hot countries, and causes emaciation, anæmia, and frequently death.

STICHOCHROME (stik′o-krōm). Any nerve-cell having the stainable substance (chromophilic bodies) arranged in more or less regular striæ or layers.

TELODENDRION (te-lo-den′dre-on). A motor end-plate or other terminal part of a dendron.

TELOPHASE (te′lo-fāz). One of the later stages of karyokinesis in which the daughter-nuclei are formed.

THYROGLANDIN (thi-ro-glan′din). 1. A preparation of the thyroid body, said to be an efficient therapeutic agent. 2. A therapeutic compound of thyroidin hydrochlorate and iodoglandin. Dose, from three to five grains.

THYROIODIN (thi-ro-i′o-din). Iodothyrin; an amorphous brown powder, forming the principal therapeutic extractive of sheeps' thyroids. It is said to contain nine per cent. of iodine and one-half per cent. of phosphorus, and has a stimulant effect upon the circulatory and nervous systems. It is used in myxœdema, rickets, corpulency, etc. Dose, from four to twelve grains.

TOXICOMUCIN (toks″ik-o-mu′sin). A poisonous albuminoid substance derived from cultures of the tubercle-bacillus.

TOXINÆMIA (toks-in-e′me-ah). The poisoning of the blood with toxins.

TOXIPEPTONE (toks-e-pep′tōn). A poisonous proteid or albuminoid substance allied to peptone; especially one produced from peptones by the action of the comma-bacillus.

TOXOALEXIN (toks″o-al-eks′in). An alexin which tends to produce immunity to bacterial toxins, including toxosozins and toxophylaxins.

Toxoid (toks'oid). A transformation product of a toxin, no longer toxic, but capable of uniting with the functionating element of the cells. A toxoid with a greater affinity for the cells than the antitoxin is called a *protoxoid;* one with the same affinity, a *syntoxoid;* one with less affinity, an *epitoxoid.*

Ureteroenterostomy (u-re"ter-o-en-ter-os'to-me). The artificial formation of a passage from a ureter to the intestine.

Ureteronephrectomy (u-re"ter-o-nef-rek'to-me). Extirpation of a kidney and its ureter.

Ureteroproctostomy (u-re"ter-o-prok-tos'to-me). The operation of forming an artificial passage between the ureter and the anus.

Ureteropyelitis (u-re"ter-o-pi-el-i'tis). Inflammation of a ureter and of the renal pelvis.

Ureteropyelonephritis (u-re"ter-o-pi"el-o-nef-ri'tis). Inflammation of the ureters and the pelvis of the kidney.

Urethrectomy (u-rēth-rek'to-me). The surgical removal of the urethra or a part of it.

Urethremphraxis (u-rēth-rem-fraks'is). Obstruction of the urethra.

Urotropin (u-rot'ro-pin). $(CH_2)_6N_4 = C_6H_{12}N_4$; hexamethylentetramin; a crystalline substance, soluble in water, slightly so in alcohol, and nearly insoluble in ether. It is a diuretic and a solvent of uric acid, and is used in pyelitis and cystitis, also in typhoid fever. Dose, from eight to thirty grains.

Vasculitis (vas-ku-li'tis). Inflammation of a vessel.

Vasectomy (vas-ek'to-me). The surgical removal of the vas deferens.

Widal Test (ve'dahl). A test for typhoid fever, performed by adding one part of blood-serum from a suspected case to twenty parts of a diluted bouillon-culture of typhoid bacilli. In typhoid cases a characteristic reaction occurs, consisting of an aggregation of the bacilli into groups (*clumping*), followed by a gradual loss of motility on the part of the bacteria.

INDEX TO VOLUME II.

(ELEVENTH SERIES.)